Including Ham Radio Fun!

73 Amateur Radio Today

JUNE 1997
ISSUE #441
USA $3.95
CANADA $4.95

International Edition

Bargain Hunting the Ham Nets

Computer Rig Controller

Thru-Glass Mag-Mount

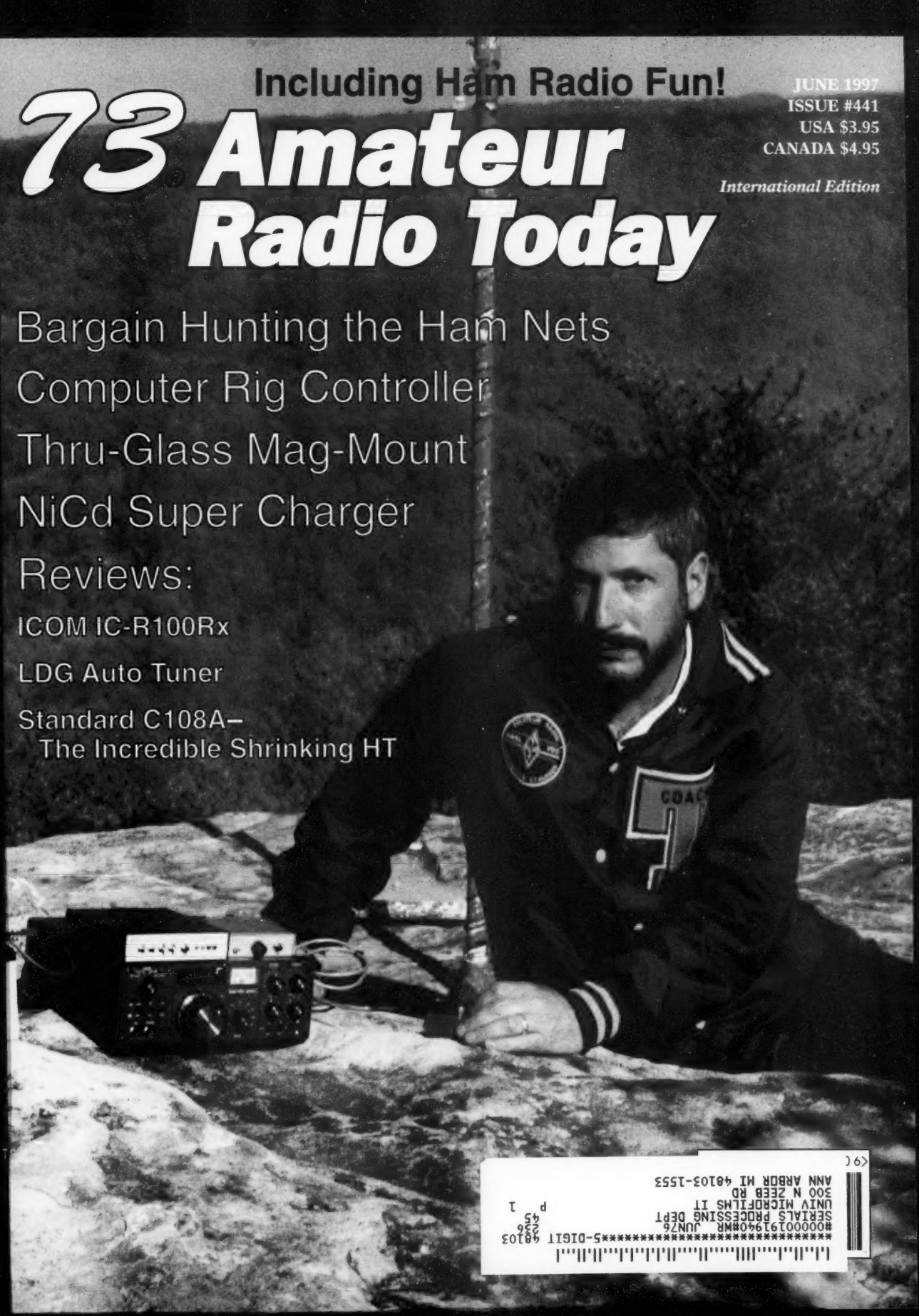
NiCd Super Charger

Reviews:

ICOM IC-R100Rx

LDG Auto Tuner

Standard C108A–
The Incredible Shrinking HT



I.I..II.I...III.....II.....II.I.I.I.I...II.II..I
**********5-DIGIT 48103
#000001919408MR JUN76
SERIALS PROCESSING DEPT
UNIV MICROFILMS IT
300 N ZEEB RD
ANN ARBOR MI 48103-1553

Finally – A Professional-Quality Receiver to Monitor Weather Broadcasts!

NEW **Our new RWX is a very sensitive and selective Hamtronics® grade receiver to monitor critical NOAA weather broadcasts.**

Excellent 0.15µV sensitivity provides good reception even at distances of 70 miles or more with suitable antenna. No comparison with ordinary consumer radios!

Automatic mode provides storm watch, alerting you by unmuting receiver and providing an output to trip remote equipment when an alert tone is broadcast.

Essential for airports, police and fire departments, CAP, broadcast stations, state and local emergency managers, amateur repeaters – anyone needing a professional quality receiver. Because of its reasonable price, it is also handy for bikers, hikers, boaters, hunters, farmers – or anyone who needs up-to-date weather info and emergency warnings, even from distant stations.

Small enough for emergency or portable use, it can even be powered from a small 9-12V battery when needed. Crystal controlled for accuracy; **all 7 channels provided** (162.40 to 162.55).

You can buy just the receiver pcb module in kit form or buy the kit with an attractive metal cabinet, AC power adapter, and built-in speaker. It is also available factory wired and tested.

- RWX Rcvr kit, PCB only $79
- RWX Rcvr kit with cabinet, speaker, & AC adapter $99
- RWX Rcvr wired/tested in cabinet with speaker & adapter $139

WWV RECEIVER

NEW Get time and frequency checks without buying multiband hf rcvr. Hear solar activity reports affecting radio propagation. Very sensitive and selective crystal controlled superhet, dedicated to listening to WWV on 10.000 MHz. Performance rivals the most expensive receivers.

- **RWWV Rcvr** kit, PCB only $59
- **RWWV Rcvr** kit with cabt, spkr, & 12Vdc adapter $89
- **RWWV Rcvr** w/t in cabt with spkr & adapter $129

WEATHER FAX RECEIVER

Join the fun. Get striking images directly from the weather satellites! A very sensitive wideband fm receiver **optimized for reception of NOAA APT and Russian Meteor weather fax** images on the 137 MHz band.

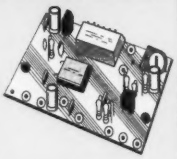
The R139 is lower cost and easier to maintain than synthesized units. And it is designed from the ground up for optimum satellite reception; not just an off-the-shelf scanner with a shorted-out IF filter!

Covers all five satellite channels. Scanner circuit and recorder control allow you to automatically search for and tape signals as satellites pass overhead, even while away from home.

- **R139 Receiver Kit** less case $159
- **R139 Receiver Kit** with case and AC power adapter $189
- **R139 Receiver w/t** in case with AC power adapter $239
- Internal PC Demodulator Board and Imaging Software $289
- Turnstile Antenna $119
- Weather Satellite Handbook $20

SUBAUDIBLE TONE ENCODER/DECODER

NEW **Access all your favorite closed repeaters with TD-5 CTCSS Encoder/Decoder**

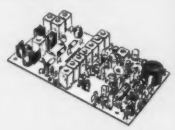


Encodes all standard subaudible tones with crystal accuracy and convenient DIP switch selection. Comprehensive manual also shows how you can set up a front panel switch to select between tones for several repeaters. Receiver **decoder** can be used to mute receive audio and is optimized for installation in repeaters to provide closed access. High pass filter gets rid of annoying buzz in receiver.

- **TD-5** CTCSS Encoder/Decoder Kit ..... only **$39**
- **TD-5** CTCSS Encoder/Decoder Wired/tested **$59**

HIGH QUALITY VHF & UHF FM XMTR AND RCVR MODULES

FM EXCITERS: 2W output, continuous duty.



- **TA51:** for 6M, 2M, 220 MHz .. **kit $99, w/t $169.**
- **TA451:** for 420-475 MHz. ..... **kit $99, w/t $169.**
- **TA901:** for 902-928 MHz, (0.5W **out**).....**w/t $169.**

VHF & UHF POWER AMPLIFIERS.
Output levels from 10W to 100W **Starting at $99.**

FM RECEIVERS:

- **R100 VHF FM RECEIVERS** Very sensitive – 0.15µV. Superb selectivity – both crystal and ceramic IF filters, >100 dB down at ±12kHz, best available anywhere, flutter-proof squelch. For 46-54, 72-76, 140-175, or 216-225 MHz. ..... **kit $129, w/t $189**
- **R144/R220 RCVRS.** Like R100, for 2M or 220 MHz, with helical resonator in front end..... **kit $159, w/t $219**
- **R451 FM RCVR,** for 420-475 MHz. Similar to R100 above. ..... **kit $129, w/t $189**
- **R901 FM RCVR,** 902-928MHz ..... **$159, w/t $219**

TRANSMITTING AND RECEIVING CONVERTERS

Go on a ham satellite adventure! Add another band for the next contest. Thrill in the excitement of building your own gear, and save a bundle.

No need to spend thousands on new transceivers for each band!

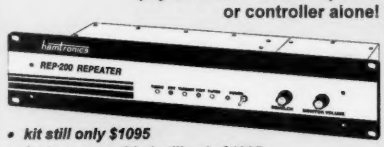
- Convert vhf and uhf signals to/from 10M.
- Even if you don't have a 10M rig, you can pick up very good used xmtrs & rcvrs for next to nothing.
- Receiving converters (shown above) available for various segments of 6M, 2M, 220, and 432 MHz.
- Kits from $49, wired/tested units only $99.

- Xmitting converters (at left) for 2M, 432 MHz.
- Kits only $89 vhf or $99 uhf.
- Power amplifiers up to 50W output.

Get more features for your dollar with our

REP-200 REPEATER

A microprocessor-controlled repeater with full autopatch and many versatile dtmf control features at less than you might pay for a bare-bones repeater or controller alone!



- ***kit still only $1095***
- ***factory assembled still only $1295***

50-54, 143-174, 213-233, 420-475 MHz. (902-928 MHz slightly higher.) **FCC type accepted** for commercial service in 150 & 450 MHz bands.

Digital Voice Recorder Option. Allows message up to 20 sec. to be remotely recorded off the air. Play back at user request by DTMF command, or as a periodical voice id, or both. **Great for making club announcements!** ..... only $100.

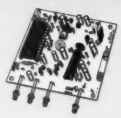
REP-200C Economy Repeater. Real-voice ID, no dtmf or autopatch. ..... Kit only $795, w&t $1195.

REP-200N Repeater. Without controller so you can use your own. ..... Kit only $695, w&t $995.

You'll KICK Yourself

If You Build a Repeater

Without Checking Out Our Catalog First!



Hamtronics has the world's most complete line of modules for making repeaters. In addition to exciters, pa's, and receivers, we offer the following controllers.

COR-3. Inexpensive, flexible COR module with timers, courtesy beep, audio mixer. ..... **only $49/kit, $79 w/t**

CWID. Traditional diode matrix ID'er. ..... **kit only $59**

CWID-2. Eprom-controlled ID'er. .. **only $54/kit, $79 w/t**

DVR-1. Record your own voice up to 20 sec. For voice id or playing club announcements. ..... **$59/kit, $99 w/t**

COR-4. Complete COR and CWID all on one board. ID in eprom. Low power CMOS. ..... **only $99/kit, $149 w/t**

COR-6. COR with real-voice id. Low power CMOS, non-volatile memory. ..... **kit only $99, w/t only $149**

COR-5. µP controller with autopatch, reverse ap, phone remote control, lots of DTMF control functions, all on one board, as used in REP-200 Repeater. ..... **$379 w/t**

AP-3. Repeater autopatch, reverse autopatch, phone line remote control. Use with TD-2. ..... **kit $89**

TD-2. Four-digit DTMF decoder/controller. Five latching on-off functions, toll call restrictor. ..... **kit $79**

TD-4. DTMF controller as above except one on-off function and no toll call restrictor. Can also use for selective calling; mute speaker until someone pages you... **kit $49**

LOW NOISE RECEIVER PREAMPS

LNG-( ) $GaAs$ FET PREAMPS
STILL ONLY $59!

- Make your friends sick with envy! Work stations they don't even know are there.
- Install one at the antenna and overcome coax losses.
- *Available for 28-30, 46-56, 137-152, 152-172, 210-230, 400-470, and 800-960 MHz bands.*

LNW-( ) ECONOMY PREAMPS
ONLY $29 kit, $44 wired/tested

- Miniature MOSFET Preamp
- Solder terminals allow easy connection inside radios.
- *Available for 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, and 400-500 MHz bands.*

- Buy at low, factory-direct net prices and save!
- For complete info, call or write for free catalog.
- Order by mail, fax, or phone (9-12 AM, 1-5 PM eastern time)
- Min. $5 S&H charge for first pound plus add'l weight & insurance
- Use VISA, Mastercard, Discover, check, or UPS C.O.D.

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e-mail. jv@hamtronics.com

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RAMSEY

Synthesized FM Stereo Transmitter

Microprocessor controlled for easy freq programming using DIP switches, no drift, your signal is rock solid all the time - just like the commercial stations. Audio quality is excellent, connect to the line output of any CD player, tape deck or mike mixer and you're on-the-air. Foreign buyers will appreciate the high power output capability of the FM-25; many Caribbean folks use a single FM-25 to cover the whole island! New, improved, clean and hum-free runs on either 12 VDC or 120 VAC. Kit comes complete with case set, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized FM Stereo Transmitter Kit $129.95

Tunable FM Stereo Transmitter

A lower cost alternative to our high performance transmitters. Offers great value, tunable over the 88-108 MHz FM broadcast band, plenty of power and our manual goes into great detail outlining aspects of antennas, transmitting range and the FCC rules and regulations. Connects to any cassette deck, CD player or mixer and you're on-the-air, you'll be amazed at the exceptional audio quality! Runs on internal 9V battery or external power from 5 to 15 VDC, or optional 120 VAC adapter. Add our matching case and whip antenna set for a nice finished look.

FM-10A, Tunable FM Stereo Transmitter Kit $34.95
CFM, Matching Case and Antenna Set. $14.95

RF Power Booster Amplifier

Add some serious muscle to your signal, boost power up to 1 watt over a frequency range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM Stereo transmitters, providing radio service through an entire town. Power required: 12 to 15 volts DC at 250mA, gain of 38dB at 10 MHz, 10 dB at 1000 MHz. For a neat, professionally finished look, add the optional matching case set.

LPA-1, Power Booster Amplifier Kit $39.95
CLPA, Matching Case Set for LPA-1 Kit. $14.95
LPA-1WT, Fully Wired LPA-1 with Case $99.95

Micro FM Wireless Mike

World's smallest FM transmitter. Size of a sugar cube! Uses SMT (Surface Mount Technology) devices and mini electret condenser microphone, even the battery is included. We give you two complete sets of SMT parts to allow for any errors or mishaps-build it carefully and you've got extra SMT parts to build another! Audio quality and pick-up is unbelievable, transmission range up to 300 feet, tunable to anywhere in standard FM band 88 to108 MHz. 7/8"w x 3/8"h x 3/4"h.

FM-5 Micro FM Wireless Mike Kit $19.95

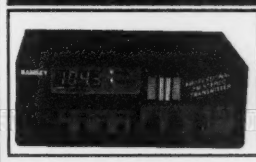
Crystal Controlled Wireless Mike

Super stable, drift free, not affected by temperature, metal or your body! Frequency is set by a crystal in the 2 meter Ham band of 146.535 MHz, easily picked up on any scanner radio or 2 meter rig. Changing the crystal to put frequency anywhere in the 140 to 160 MHz range-crystals cost only five or six dollars. Sensitive electret condensor mike picks up whispers anywhere in a room and transmit up to 1/4 mile. Powered by 3 volt Lithium or pair of watch batteries which are included. Uses the latest in SMT surface mount parts and we even include a few extras in case you sneeze and loose a part!

FM-6, Crystal Controlled FM Wireless Mike Kit $39.95
FM-6WT Fully Wired FM-6 ..... $69.95

Call for our Free Catalog !

Super Pro FM Stereo Radio Transmitter



A truly professional frequency synthesized FM Stereo transmitter station in one easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set frequency easily with the Up/Down freq buttons and the big LED digital display. Plus there's input low pass filtering that gives great sound no matter what the source (no more squeals or swishing sounds from cheap CD player inputs!) Peak limiters for maximum 'punch' in your audio - without over modulation, LED bargraph meters for easy setting of audio levels and a built-in mixer with mike and line level inputs. Churches, drive-ins, schools and colleges find the FM-100 to be the answer to their transmitting needs, you will too. No one offers all these features at this price! Kit includes sharp looking metal cabinet, whip antenna and 120 volt AC adapter. Also runs on 12 volts DC.

We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

FM-100, Professional FM Stereo Transmitter Kit $299.95
FM-100WT, Fully Wired High Power FM-100. ..... $429.95

Speech Descrambler Scrambler

Decode all that gibberish! This is the popular descrambler / scrambler that you've read about in all the Scanner and Electronic magazines. The technology used is known as speech inversion which is compatible with most cordless phones and many police department systems, hook it up to scanner speaker terminals and you're in business. Easily configured for any use: mike, line level and speaker output/inputs are provided. Also communicate in total privacy over telephone or radio, full duplex operation - scramble and unscramble at the same time. Easy to build, all complex circuitry contained in new custom ASIC chip for clear, clean audio. Runs on 9 to 15VDC, RCA phono type jacks. Our matching case set adds a super nice professional look to your kit.

SS-70A, Speech Descrambler/Scrambler Kit $39.95
CSS, Custom Matching Case and Knob Set $14.95
SS-70AWT, Fully Wired SS-70A with Case $79.95
AC12-5, 12 Volt DC Wall Plug Adapter $9.95

Tone-Grabber Touch Tone Decoder / Reader

Dialed phone numbers, repeater codes, control codes, anywhere touch-tones are used, your TG-1 will decode and store any number it hears. A simple hook-up to any radio speaker or phone line is all that is required, and since the TG-1 uses a central office quality decoder and microprocessor, it will decode digits at virtually any speed! A 256 digit non-volatile memory stores numbers for 100 years - even with the power turned off, and an 8 digit LED display allows you to scroll through anywhere in memory. To make it easy to pick out numbers and codes, a dash is inserted between any group or set of numbers that were decoded more than 2 seconds apart. The TG-1 runs from any 7 to 15 volt DC power source and is both voltage regulated and crystal controlled for the ultimate in stability. For stand-alone use add our matching case set for a clean, professionally finished project. We have a TG-1 connected up here at the Ramsey factory on the FM radio. It's fun to see the phone numbers that are dialed on the morning radio show! Although the TG-1 requires less than an evening to assemble (and is fun to build, too!), we offer the TG-1 fully wired and tested in matching case for a special price.

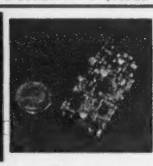
TG-1, Tone Grabber Kit. $99.95
CTG, Matching Case Set for TG-1 Kit. $14.95
TG-1WT, Fully Wired Tone Grabber with Case $149.95
AC12-5, 12 Volt DC Wall Plug Adapter $9.95

Mini-Peeper Micro Video Camera

Super small, high quality fully assembled B & W CCD TV camera the size of an ice cube! Provides excellent pictures in low light (2 lux), or use our IR-1 Infra-Red light source to invisibly illuminate an entire room on a pitch black night! Imagine the possibilities... build it into a smoke detector, wall clock, lamp, book, radio. Exact same camera that's in big buck detective catalogues and stores. Kit includes: fully assembled CCD camera module, connectors, interface PC board kit with proper voltage regulation and filtering, hook-up details, even a mini microphone for sensitive sound! Two models available: Wide Angle Lens 3.6mm/f2, adjustable focus lens, 92 degree view; Pinhole Lens 5.5mm/f4.5, 60 degree view. The Pinhole Lens is physically much flatter and provides even greater depth of focus. The camera itself is 1.2" square. The Wide Angle Lens is about 1" long, Pinhole Lens about 1/2", interface PC board is 1" x 2" and uses RCA jacks for easy hook-up to VCRs, TVs or cable runs. Power required is 9 to 14 VDC @ 150 mA. Resolution: 380 x 350 lines. Instruction manual contains ideas on mounting and disguising the Mini-Peeper along with info on adding one of our TV Transmitter kits (such as the MTV-7 unit below) for wireless transmission!

MP-1, Wide Angle Lens CCD TV Camera Outfit $169.95
MP-1PH, Pin-Hole Lens CCD TV Camera Outfit $189.95

MicroStation Synthesized UHF TV Transmitter



Now you can be in the same league as James Bond. This transmitter is so small that it can fit into a pack of cigarettes - even including a CCD TV camera and battery! Model airplane enthusiasts put the MTV-7A into airplanes for a dynamite view from the cockpit, and the MTV-7A is the transmitter of choice for balloon launches. Transmitter features synthesized, crystal controlled operation for drift-free transmission of both audio and video on your choice of frequencies: Standard UHF TV Channel 52 (which should only be used outside of the USA to avoid violating FCC rules), and 439.25 MHz or 911.25 MHz which are in the amateur ham bands. The 439.25 MHz unit has the nifty advantage of being able to be received on a regular 'cable-ready' TV set tuned to Cable channel 68, or use our ATV-74 converter and receive it on regular TV channel 3. The 911.25 MHz unit is suited for applications where reception on a regular TV is not desired, an ATV-79 must be used for operation. The MTV-7A's output power is almost 100 mW, so transmitting range is pretty much 'line-of-sight' which can mean many miles! The MTV-7A accepts standard black and white or color video and has its own, on-board, sensitive electret micorphone. The MTV-7A is available in kit form or fully wired and tested. Since the latest in SMT (Surface Mount Technology) is used to provide for the smallest possible size, the kit version is recommended for experienced builders only. Runs on 12 VDC @ 150 mA and includes a regulated power source for a CCD camera.

MTV-7A, UHF TV Channel 52 Transmitter Kit $159.95
MTV-7AWT, Fully Wired Channel 52 Transmitter $249.95
MTV-7A4, 439.25 MHz TV Transmitter Kit $159.95
MTV-7A4WT, Fully Wired 439.25 MHz Transmitter $249.95
MTV-7A9, 911.25 MHz TV Transmitter Kit $179.95
MTV-7A9WT, Fully Wired 911.25 MHz Transmitter $269.95
ATV-74, 439.25 MHz Converter Kit $159.95
ATV-74WT, Fully Wired 439.25 MHz Converter $249.95
ATV-79, 911.25 MHz Converter Kit $179.95
ATV-79WT, Fully Wired 911.25 MHz Converter $269.95

RAMSEY ELECTRONICS, INC.
793 Canning Parkway
Victor, NY 14564

Order Toll-free: 1-800-446-2295
Sorry, no tech info or order status at this number

Technical Info, Order Status
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VISA MasterCard DISCOVER

ORDERING INFO: Satisfaction Guaranteed. Examine for 10 days, if not pleased, return in original form for refund. Add $4.95 for shipping, handling and insurance. Orders under $20, add $3.00. NY residents add 7% sales tax. Sorry, no CODs. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.

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SWITCHING POWER SUPPLIES

	CONT.	ICS	WT.(LBS)
SS-10	7	10	3.2
SS-12	10	12	3.4
SS-18	15	18	3.6
SS-25	20	25	4.2
SS-30	25	30	5.0

SS-25M With volt & amp meters
SS-30M With volt & amp meters

ASTRON POWER SUPPLIES

• HEAVY DUTY • HIGH QUALITY • RUGGED • RELIABLE •

SPECIAL FEATURES

- SOLID STATE ELECTRONICALLY REGULATED
- FOLD-BACK CURRENT LIMITING Protects Power Supply from excessive current & continuous shorted output
- CROWBAR OVER VOLTAGE PROTECTION on all Models except RS-3A, RS-4A, RS-5A, RS-4L, RS-5L
- MAINTAIN REGULATION & LOW RIPPLE at low line input Voltage
- HEAVY DUTY HEAT SINK • CHASSIS MOUNT FUSE
- THREE CONDUCTOR POWER CORD except for RS-3A
- ONE YEAR WARRANTY • MADE IN U.S.A.

PERFORMANCE SPECIFICATIONS

- INPUT VOLTAGE: 105-125 VAC
- OUTPUT VOLTAGE: 13.8 VDC ± 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE Less than 5mv peak to peak (full load & low line)
- All units available in 220 VAC input voltage (except for SL-11A)

SL SERIES

• LOW PROFILE POWER SUPPLY

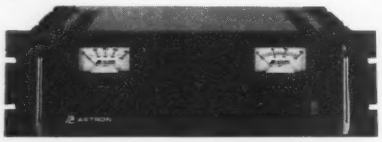
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
SL-11A	•	•	7	11	2⅝ × 7⅞ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅞ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

RS-L SERIES

• POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES



MODEL RM-35M

• 19" RACK MOUNT POWER SUPPLIES

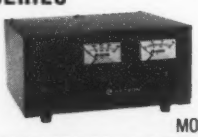
MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

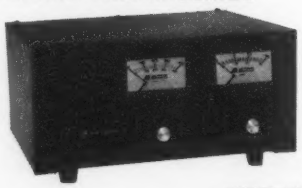
RS-M SERIES



MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

VS-M AND VRM-M SERIES

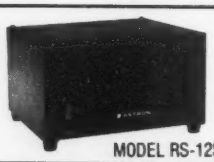


MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
VS-70M	67	34	16	70	6 x 13¾ x 12⅛	48
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES



MODEL RS-12S

• Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅞ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

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73 Amateur Radio Today

Including Ham Radio Fun!

JUNE 1997
ISSUE #441

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On the cover: Conard Murray WS4S captured Jeff Gold AC4HF mountaintopping with his LDG Auto Tuner. Both are from Cookeville TN. Next month: YOUR cover shot? Submissions gladly welcomed. Why not make a little extra cash?

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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NEVER SAY DIE

Wayne Green W2NSD/1

Bio News

Have you built a bioelectrifier (May 1996, May 1997 *73*) so your doctor can check out its potential for eliminating viruses, yeasts, microbes, fungi, and parasites from the blood of his patients yet? I've been getting some enthusiastic letters from readers reporting remarkable results: "More black hairs on my head—teeth and gums improved—improved vision—improved elimination regularity—it seems like every day I discover something that works better, what a miracle!"

Well, you can lead a horse to water. Through my book reviews (etc.) I've pointed out how you can add at least another 20-30 years to your life expectancy. Years of robust health, not doddering around a retirement home, awaiting the inevitable heart attack, cancer or stroke. But getting you to change your lifestyle by taking advantage of this information is totally beyond me.

Yes, you want me to write about amateur radio. And hamming is fun. It's a lot more fun when you are 100% healthy. And it's a lot more fun when you take advantage of the adventure the hobby provides. It may be putting up a 500-foot antenna via a kite or balloon, or lofting a little ATV camera via a balloon. Or maybe a little long weekend trip to St. Pierre (FP8) for a mini-DXpedition. Or getting together with a half dozen other adventurers for a few days on Navassa (KP1), fielding the humongous pileups.

Yes, of course I'm frustrated at your insisting on commuting to work every day instead of having your own business. You obviously haven't read Danko's *The Millionaire Next Door*. Or my book, *Making Money*. A little over 1% of Americans are millionaires, so is it really all that difficult for you to imagine being more successful than 99 of your friends? It doesn't take much more effort, only a redirecting of your life—out of the rut the other 99 are in. And, in the case of healthy living, out of the rut 99.999% of the others are in. You only have to look in the market baskets at the supermarket and then at the pushers to see the correlation between the food they're buying and how healthy they don't look.

In the short run it does seem as though the bioelectrifier can work some miracles. In the long run it's your mouth that will work more health miracles, and your understanding of the secret of making money that will determine whether you have any real freedom or not. I hope you'll opt for change so that in a couple of years you'll be asking me to go along on a DXpedition with you to Minerva Reef or some other weird place. I'll bring a rig and my scuba gear and we'll have a ball! But if you're going to climb that ladder up the cliff at Navassa, you're going to need all the energy you can muster. It's a corker.

Pirating

I was talking with John Ramsey of Ramsey Electronics the other day and I asked him which of his kits was his best seller. He said it was his FM transmitter kit. It seems that my preaching about entrepreneur-ialism hasn't fallen totally on numbed ears and school-system de-motivated psyches. More and more hams are going into business for themselves selling, installing, and servicing low powered FM transmitters. The applications? They're only limited by their imaginations.

Some businesses and hospitals use them for distributing music. Some use them for paging systems. Others set them up with a cassette recorder, CD player and a mixing board as a pirate broadcasting station serving their community. No, the FCC is not delighted about this, but unless there are a bunch of complaints, not much seems to happen. And then, they issue a warning before sending in the swat team to confiscate everything in sight and levy a fine or impose a prison stay.

These low powered rigs don't cause much trouble, though now and then some enterprising pirates can't help setting up an outside antenna and adding a pair of shoes. Yes, Ramsey sells a beaut of a 30-watt amplifier which absolutely, positively should not be used for pirating.

Some hams are getting real estate agents to set up the FM rigs in houses they have for sale, using an endless loop tape telling about the property. Prospects have merely to tune their car stereo to the channel and get the sales story when they visit the properties recommended by the realtor.

Now get those little gray cells out of neutral, where they've been idling for the last few years, and come up with more uses for these li'l dyn-o-mite gadgets.

Golly, what a great pirate station I could run! I've got a killer collection of CDs for music, and an endless bunch of things to talk about. Ask anyone who's heard me at Dayton. What I don't have is the time to do something fun like that. Also, while the FCC may find it merely annoying when they get complaints about a pirate FM station, if the guy running it turns out to be a ham, he'll probably lose his ticket. Sell 'em, install 'em, service 'em, but don't operate 'em if they're going to cover more than is permitted for low powered unlicensed devices.

FCC Swat Teams

One part of the new Communications Act that Congress passed last year was a sleeper called the "Communications Decency Act." This beaut provides criminal sanctions (a.k.a. prison) if a minor is exposed to "indecent" or "patently offensive" material via telecommunications, and that includes amateur radio as well as the Internet—and even Howard Stern. A lot of fuddy-duddy groups are upset over this—like the ACLU.

Of course there's no way to define "patently offensive," so this will be great meat for lawyers. Well, they don't have nearly enough to do, as we can see from the endless law firm ads on TV begging us to let them sue someone for us and get all that money we're rightly due.

If the FCC swat teams start monitoring 75m there are several infamous nets which will keep them busy. Well, I've given up waiting for our only national organization (which I won't identify here for fear of being accused falsely of ARRL-bashing) to take some shreds of responsibility in this area, but they don't seem to give a hoot what awful things are going on in our ham bands.

I'll have to get a copy of the law and see if the swat teams can confiscate not only the radio equipment being used to create this poisoning of minor minds, but maybe they can confiscate the house and other property too, like they do when someone merely alleges that drugs are on the premises.

Hey, maybe our ham clubs can form vigilante teams to make citizens' arrests of foul-mouthed hams. We should look into that, eh? But let's get busy on this before some well-meaning do-gooders spoil everything by getting the law rescinded.

Positive Action

Here's what the ARRL should have done instead of blustering: They should have used a positive approach instead of a negative one in dealing with the LEO ogre. John Keating WA2FVL has the right idea. He's written to his congressman explaining what is going on. The result was that a Representative who'd voted to sell frequencies now has had a change of heart. Congressmen are dealing with endless bills, many of which they know little about, or have been pressured on by lobbyists. Like the general public, they know almost nothing about amateur radio—much less that there are some agitated voters in their district with a special interest in preserving our frequencies.

Instead of calling the LEO people names we should spend our efforts educating the people who are going to make the bottom line decision: Congress.

Conspiracy

Dagnab it, while I'm suspicious of most of these conspiracy theories that readers write to me about, there is one where capitalism is again biting us where it hurts. The multinational pharmaceutical giants are not just writing the American laws for us to favor their products, now they're at work on a global basis. Well, when you're making the kind of profits they are, why should they think small? Why not influence the UN, the World Health Organization, the FDA, NIH, and other assorted havens for tenured bureaucrats shuffling papers until their pensions kick in?

Not only are these giants in almost total control of our American medical industry, but also the European.

So what are they plotting now? They want to close down the alternative health industry, which is made up of small companies, and thus is vulnerable to giant lobbying power. And that includes vitamins and food supplements, unless they are prescribed by a doctor. Well, that ought to quadruple their cost. Or worse.

Yes, I know that the alternative health industry is in one heck of a mess. They're not allowed to promise health benefits, and the medical industry refuses to test their products, so the public has no way to know what works for what and what doesn't.

I get audio tapes, videos, books and direct mail promotions for endless nostrums. If I got sucked in on all this stuff I'd be spending hundreds of dollars a week and doing who knows what to my body.

Yet, when I read a couple of the medical newsletters that I've come to trust (such as *Second Opinion)* by Douglass (who does not answer his damned mail), I find him extolling the virtues of essiac for people who've misnourished themselves into cancer. Well, the book on essiac is on my list of books you're crazy if you don't read, so I'm pleased to see my opinion confirmed.

Unless you make a fuss over this with your representatives in Congress you're going to get screwed. Again.

CC&R

Read the fine print! If you are moving into any kind of a community you'd better look carefully before you sign that contract. Look for the Covenants, Conditions and Restrictions. And in them, more often than not, you'll find that you are not permitted to put up any kind of an outside antenna.

Talk about ham emasculation! A true-blue ham would prefer a tarpaper shack out in the country to a showpiece house where no antennas are permitted. We hams live and die by our antennas. After all, what's more important, impressing some people (non hams, of course) with how much money you were able to spend on a house, or to have a hellaceous signal? No contest.

Before you move make damned sure you can put up any kind of a tower you want—that you can swing a 40m beam from it if you feel like it. I've always been a 20m person myself. Besides, a 32-foot beam is a lot easier to put up than a 64-foot monster.

Any real ham wouldn't move into a community anyway. That means TVI, angry neighbors, and aggravation. My nearest neighbor is over a half mile away, and I like that just fine.

If you're stuck because of your job in a city or a crowded suburb, isn't it about time to start planning ahead for that ideal QTH? When you're working for someone else you are never going to be really free. Lincoln freed the slaves, but our school system hasn't. It's planned to condition you to shut up, get a job, and work your ass off until you can retire on social security. Retirement used to include a pension which provided enough money for a camper, but the big companies have figured out that downsizing your job a few years before retirement is cheaper.

Okay, I'm a cynic. In my book on making money I explain that you should only work for other people long enough to learn what you need to know to run your own business. And that's maybe two to five years, if you haven't had your motivation gutted by the "system."

Well, anyway, watch out for those CC&R clauses and avoid any community that has 'em in the contract.

If It Ain't Broke

If you consider the federal deficit, and not even counting trillions of dollars in unfunded future mandatory expenses, our country is broke. Okay, so let's fix it. Are you interested in helping? Hmm, I was afraid of that.

Red-Green

In my editorials and in my review guide to books "you're crazy if you don't read" I've asked the readers to let me know of any really important books I may have missed. After all, I've only been able to read a few thousand books out of the millions of titles published, so I need all the help I can get to sort the wheat from the chaff. And, hoo-boy, there sure is a lot of chaff.

Of course it's the same thing with music, which is why I produced over a hundred of my *Adventures In Music* series of CDs, each with the top-rated track from about 15 independently produced CDs. Since the six major music giants make damned sure that you aren't going to hear independent music by investing over $100 million a year in payoffs to radio station music directors, this seemed like a practical way to circumvent the "system."

Getting back to books, I've been very fortunate so far in having the authors of some outstanding books send me copies of their work. The first that comes to mind is *Vibrations* by Owen Lehto, which is a serious *must* read. The second was René's *NASA Mooned America*. I have to admit that I get a chuckle every time I get an angry letter from a reader over my being taken in by René's claiming that our astronots never really went to the moon. Margaret Chaney W8ONS sent me a copy of her *Red World - Green World*. It's a $12 book (incl. s/h) that can make a major difference in your life. Please note, I did not say "might make a difference." Read this book or else.

Even though I've never led you astray with my book recommendations, you still want to know what the book is about before you risk a whopping $12, right? Oh, ye of little faith. Oh, ye big tightwad.

Okay, okay, here's the story. Margaret says our world is divided into two basic categories—which she labels for convenience as red and green. This holds for people, animals, foods, trees, and even rocks. If you are a "red-world" person and eat "green-world" food you're going to suffer the consequences. And vice versa. Yes, she provides a simple test to determine which world you or any food, etc., is in. It's a test anyone can make any time and it is failure proof. It works every time.

Margaret points out that medications fall into the red-green dichotomy too, so if your doctor prescribes a red-world pill for you and you're a green-world person, that's bad news. She points out that twins invariably are split, with one being red-world and the other green. Why nature (God?) came up with this dichotomy we don't know, and it's amazing that no one has noticed this split before. It sure explains why Sherry and I eat different foods. We've often noticed this. When we go to a buffet restaurant we always end up with completely different foods on our plates. At home she fixes her meals and I

Continued on page 53

LETTERS

From the Ham Shack

Thomas M. Miller WA8YKN, Richmond IN. Bioelectrifier Update: I'm glad so many readers enjoyed my article in the May 1996 issue of *73*. There has been a much greater response than I expected, many wanting circuit boards. This caught me by surprise, since the thrust of the article was on how to make the circuit boards! However, I talked with FAR Circuits at the Dayton Hamvention, and they will be selling boards for the Bioelectrifier. Drop them a line at 18N640 Field Court, Dundee IL 60118, or call them at (847) 836-9148.

I had an interesting experience while playing with different frequencies for the Bioelectrifier. When the frequency was around 100 reversals per minute I noticed that my heart rate increased to match it! I did this twice to make sure that it wasn't a fluke. This may not affect everyone else this way—I get a similar effect from caffeine. After that I limited my experiments to lower frequencies, around three seconds per reversal, which seemed to have a very relaxing effect. I recommend changing C1 and C2 from 4.7 µF to 33 µF or more to get the lower frequency limit down into this range. Another minor change I recommend is the addition of a 33k resistor in series with the +36 volt lead from the top battery in the stack. This will protect the optocouplers in case of an accidental short, and has the additional benefit of providing a maximum current limit for the current adjust pot—so you won't jump if you crank it up too high! Radio Shack sells a switch that mounts on the back of their potentiometers. The part number is 271-1740. If you mount this on the current-adjust pot, it will not only save you from having to make another hole, but will ensure that you always turn it on in the lowest current setting. The "aluminum foil" electrodes make a good low-resistance connection over a large area, making it unnecessary to shave the skin and use messy electrode cream, but I've noticed that after a while they get wrinkled, and the creases make "hot spots" that feel like some small critter is nibbling at your ankles! Also, there is some question of aluminum ions migrating into the blood—not a good thing, to be sure, but highly unlikely due to the polarity reversals and very tiny current. I found a pretty good solution to this. At the auto parts store, I found a roll of two-inch-wide stainless steel tape with a peel-off backing. This tape is much heavier and more resistant to wrinkling than standard foil, and it's already preglued. Also, the stainless steel should eliminate any fears of aluminum ions. I put some on two strips of vinyl and added Velcro for a very comfortable set of cuffs. J.C. Whitney also sells this tape. Call them at (312) 431-6102 and order part number 12DF3575U. Of course, the best (if most expensive) material for electrodes is silver. Large medallions containing one ounce of pure silver are available at coin shops for a small premium over the spot price of silver, and should make super electrodes. Silver is a natural antibiotic, with both antibacterial and anti-viral properties. I hope you will share your experiences with the Bioelectrifier. Remember, this device is an adjustable micro-current source for personal experimentation, and is not intended as a "medical device," nor do we claim that it is a "cure" for anything. At this point, we have virtually no experimental data, so we don't know what effects, if any, it may have. I liked Wayne's idea about using a bioelectric device as a "plant growth stimulator." In fact, I was interested enough to think up some interesting experiments to try along this line. It would be interesting to see if 50 microamps through the moist soil will enhance seed germination. Are these plants different from those that sprouted normally? Another idea is to modulate the DC current with audio! Experiment with different tones, or play music. A small audio amp and an output transformer would provide a means of modulating the 50 microamp current. It's possible that different types of music could have different effects, although I'd avoid anything that sounds like a cat being turned down in a lathe. As long as we're talking weird, how about this? If we were to reverse the transformer, with the 8 ohm winding in series with the 50 microamps, then run the 1k side to the input of the audio amp, with a 1N34 diode in series, we just might listen for sounds *from* the plant! How about listening to one plant while playing music to another one across the room? (Now *that's* weird!) The best thing about this is that (as far as I can tell) the plants have no SWAT teams or big lobbies in Congress, so it might be safe to try these experiments! In fact, I've come up with a slightly different circuit and designed a new board to go with it. It's a lot smaller—so much so that it might be hard for some people to build, but I'm willing to sell an assembled circuit board, fully tested, for $38.00 plus $2.00 for postage. I'll even include a potentiometer with a switch and a small terminal block for connecting the electrodes. You will need a small box and some batteries, available from Radio Shack. This circuit puts out the same DC current and reverses polarity just like the original Bioelectrifier. Although it's called a "Plant Stimulator," there may be many possible uses for this device. What you do with it in your own home is, of course, your own business! I'll be happy to hear about your experimental results with these devices, and I'd like to know about any other uses for them that anyone may come up with.

Beck recommends using a couple small electrodes on one wrist instead of the ankle units he first used. Well, for me that makes it a lot easier. I carry the unit in a jacket pocket and am able to type and work while zzzing myself. I use a couple of Velcro-fastened elastic straps on one wrist. There are two arteries, about an inch apart there. I've written about this before. The lower frequency to induce sleep is an interesting approach which should be explored. And certainly the Schuman 7.8 Hz frequency should be explored. I've tried to get you to read Bird's "The Secret Life of Plants" and "Secrets of the Soil." These explain about the incredible impact of music on plants (a.k.a. crops). And I have a video of a plant hooked up to an oscillator, obviously trying to imitate human speech. Why does classical music help plants grow like crazy (some farmers have loudspeakers in their fields), and rock 'n' roll stunt plant growth? And children's too, I suspect. At least mentally... Wayne.

Guy A. Matzinger KB7PNQ, Cheney WA. From my point of view, the ARRL has once again lost an opportunity to truly be the standard-bearer for amateur radio affairs—when that Board of Directors voted to support retaining the *International Morse Code* Treaty *Obligations*, interpreting the results of one more survey with the usual rationale and explanation for their actions. Any suggestions that the survey is representative of the total amateur population as a whole forget that the League's membership is less than 25% of that population, and that about one-third of those members hold Tech and Tech Plus licenses. Interestingly, less than 12% of their members operate exclusively on HF bands, with most using computers and/or keyboards for code communications. On the other hand, their French counterpart—without "rounding up the usual suspects" and with a refreshing display of truth and honesty—acknowledges that code testing is used to filter and limit participation in the hobby.

The ARRL recently asked for comments on their proposed restructuring of amateur licensing requirements—a proposal that appears to be nothing more than small bits of tinkering. Sifting through the chaff, you discover that the suggested changes are not

significant—mostly window-dressing that continues to promote segregation. However, the restructuring strategy implies that steps need to be taken to contain "perceived" abuses of the handicapped waiver provision—does the League mean to challenge the judgment of the medical profession? The proposal also suggests that there are too many amateurs to allow participation on all bands by *all* operators. Is that comment—considering the remarks of media pundits that: "the ARRL represents the *majority* of *operating* amateurs"—an admission that the *majority* of *operators* are incapable of self-controlling band occupancy?

Amateur clubs throughout the country are lamenting the failure of amateurs to upgrade and new operators to join their organizations. The argument they hear, from young and old, against either upgrading or joining *any* organization is, "the benefits are not worth it." The future of the hobby is at risk unless a way is found to attract new blood and stimulate participation in HF communications. The future of HF bands lies with spectrum use by *all* amateurs—perhaps a period of training using all the bands, with an experienced operator, prior to being issued a license would stimulate interest. We are past the point of upgrading and if a creative solution is not found to energize interest in HF operations then, as the aging old-timers fade away, so will those bands and most of amateur radio.

When an autocratic organization initiates legislation that creates preferential benefits, society becomes divided, and sooner or later, those being dominated by special interests will realize that they are being oppressed by manipulated regulations and collaborating bureaucrats—they will seek relief from that discrimination—usually to the detriment of all concerned. This nation was built on the values and principles of individual responsibility and self-determination, not by people who believe they have the right to control others. Tomorrow's technology must be accommodated—standing pat and limiting participation will almost certainly mean death for the hobby.

James Wilkins, Poolesville MD. Recently there was a local newspaper article about a lost hunting dog who took shelter in a cave containing a bear. They survived by not fighting during the emergency. What caught my attention was that the dog was eventually found because he was wearing a radio collar. It seems to me that ham clubs could gain useful publicity, probably gratitude or even occasional monetary gifts if they could sell simple dog-finders in the frequency ranges of their transmitter hunts. There are a lot of cheap crystal oscillators on the market intended for computer clocks, and the frequency selection is extensive. Lost and hungry dogs in rural areas chasing farmers' livestock get shot, with the full approval of the law. This arrangement also would save dog owners from having to buy both a transmitter and a receiver for $500 or so. Hams need a boost in their public image, as well as an outdoor break from the Internet terminal.

The idea of using a ham skill for the public good, or even—gasp—to make some money seems alien. It probably won't fly... Wayne.

Richard Heppert KC4YQL, Kingston TN. Why a filter? A letter from James Hanlon W8KGI in the March issue of *QST* titled *The Best Filter* described CW as the fairest "filter" to prove one's worthiness to use the HF bands. He describes CW as a "skill that is related to the practice of the

Continued on page 61

QRX . . .

Tech Support Has Its Moments...

So you think you're computer illiterate? Check out the following excerpts from a *Wall Street Journal* article by Jim Carlton.

1. Compaq is considering changing the command "press any key" because of the flood of calls asking where the "Any" key is.

2. AST technical support had a caller complaining that her mouse was hard to control with the dust cover on. The "dust cover" turned out to be the plastic bag the mouse was packaged in.

3. Another Compaq technician received a call from a man complaining that the system wouldn't read word processing files from his old diskettes. After troubleshooting for magnets and heat failed to diagnose the problem, it was found that the customer had labeled the diskettes and then rolled them into a typewriter to type the labels.

4. Another AST customer was asked to send a copy of her defective diskettes. A few days later a letter arrived from the customer along with Xeroxed copies of the floppies.

5. A Dell technician advised his customer to put his troubled floppy in the drive and close the door. The customer asked the tech to hold on, and was heard putting the phone down, getting up and crossing the room to close the door to his room.

6. Another Dell customer called to say he couldn't get his computer to fax anything. After 40 minutes of troubleshooting, the technician discovered the man was trying to fax a piece of paper by holding it in front of the monitor screen and hitting the "send" key.

7. Another Dell customer needed help setting up a new program, so a Dell tech suggested he go to the local Egghead. "Yeah, I got me a couple of friends," the customer replied. When told "Egghead" was a software store, the man said "Oh, I thought you meant for me to find a couple of geeks."

8. Yet another Dell customer called to complain that his keyboard no longer worked. He cleaned it by filling his tub with soap and water and soaking the keyboard for a day, then removing all the keys and washing them individually.

9. A Dell technician received a call from a customer who was enraged because his computer had told him he was "bad and an invalid". The tech explained that the computer's "bad command" and "invalid" responses shouldn't be taken personally.

10. An exasperated caller to Dell Computer Tech Support couldn't get her new computer to turn on. After ensuring the computer was plugged in, the technician asked her what happened when she pushed the power button. Her response: "I pushed and pushed on the foot pedal and nothing happens." The "foot pedal" turned out to be the computer's mouse.

True story from a Novell NetWire sysop:

Caller: "Hello, is this tech support?"

Tech: "Yes, it is, how may I help you?"

Caller: "The cup holder on my PC is broken and I am within my warranty period. How do I go about getting that fixed?"

Tech: "I'm sorry, but did you say a cup holder?"

Caller: "Yes, it's attached to the front of my computer."

Tech: "Please excuse me if I seem a bit stumped; it's because I am. Did you receive this as part of a promotional, at a trade show? How did you get this cup holder? Does it have any trademark on it?"

Caller: "It came with my computer, I don't know anything about a promotional. It just has a '4X' on it."

At this point, the tech rep had to mute the caller, because he couldn't stand it. The caller had been using the load drawer of the CD-ROM drive as a cup holder and had snapped it off the drive!

Taken from the *Elk County ARA Newsletter*, Vol. 6.3, which may or may not have been the first to borrow it from the *Wall Street Journal*.

Red Cross Calls on DARA for Help

The weekend of March 8th, 1997, the DARA van was dispatched to Cincinnati, Ohio, to assist the Cincinnati Red Cross with damage assessment activities in and around the City of Cincinnati. This callout was due to the worst flooding on the Ohio River in the past 30 years. The initial call came at about 10 a.m. on Friday when Emergency Coordinator Ernie Hudson KI8O notified Van Chairman John Phillips N8ZGT that the van was needed in Cincinnati. Plans were immediately put into action to alert the necessary personnel.

Early Saturday morning the van left the Bellefontaine Road site en route to the Red Cross Chapter in Cincinnati. After a briefing session, the van was deployed to Pendleton County, Kentucky, about 50 miles from Cincinnati. The van set up operations at Pendleton County High School. The van was to pass traffic from the Damage Assessment Teams to the Cincinnati Red Cross Emergency Operations Center. The Red Cross had 60 Damage Assessment Teams in the flooded area. They could not communicate with the EOC due to terrain and limited radio capabilities. The van was able to relay traffic to the EOC without difficulties.

The van and its crew remained in Cincinnati overnight Saturday. On Sunday morning the crew was dispatched to the Red Cross Shelter in Brookville, Kentucky, in Bracken County, farther east from the previous day's location. The Damage Assessment Teams were surveying the area northeast of Brookville, near the city of Milford. Sunday afternoon the van was relocated to Augusta, Kentucky. In Augusta, the van crew repeatedly saw extensive damage from flood waters. There were several structures more than a hundred years old that were heavily damaged by the flood. Several mobile homes were washed off their sites; all that remained was gravel and pipes sticking from the ground. The front porches from the mobile homes were located several blocks from the original sites. Everything was covered with mud and soaked with foul-smelling water. Several of the Damage Assessment Teams reported seeing only the roofs of buildings above the flooded areas.

The van continuously operated on three or four VHF and UHF frequencies, maintaining communications with the Cincinnati EOC and stations in Dayton. The stations in Dayton were prepared to assemble relief operators if the situation warranted. Also several of theDamage Assessment Teams could communicate with stations in Dayton only via the FARA 145.19 MHz repeater system. The van relied on relay traffic from the stations monitoring the 145.19 FARA system.

While the van and its crew were operating on the Kentucky side of the Ohio River, more amateur operators were busy on the Ohio side. Many

amateur operators assisted with the disaster relief operations in Ohio, Kentucky, Indiana, and Illinois.

Here are personal observations from Ron Moorefield W8ILC, D.E.C., and Ernie Hudson KI8O, E.C. Mont. Co.

"This is a summary of the Ohio River Flood and what DARA and the DARA van did on March 8-9.

"The US Weather Bureau said that this was a once-in-a-thousand-year event, especially in areas in southern Ohio and northern Kentucky along the Ohio River.

"When the DARA van was requested to support the American Red Cross Damage Assessment Teams, we saw firsthand what the force of water can do to many small communities.

"We not only supported the Red Cross near Falmouth, Kentucky, Bracken County and Augusta, Kentucky, but offered support to the Kentucky National Guard, Civil Air Patrol, and the Kentucky State Police. It was amazing that the Guard's satellite systems could not see the satellite, so we offered support to them. Also, we had to program the radios for the Civil Air Patrol.

"ARES ID cards are very important and need to be worn. These cards are usually the only thing that will allow you to cross police barriers. If you do not have an ARES ID card, please contact Ron Moorefield W8ILC.

"DARA stations that spent time in Kentucky were: N8XGA, KB8RTD, KC8AVU, W8ILC, N8UFN, KA8GOV, KB8YDS, N8ZGT, KB8PMV, N8JBL, K8QZN, N8HSU, N8TFD, N8UCL, and N3TNQ. Stations that were at the State EOC in Columbus were WD8DLQ and W8RLY. The stations that supported us in Dayton on the FARA 145.19 repeater were: N8VET, N8VVZ, KI8O, KA8OKC, N8VZV, and N8MYQ. Many thanks to the FARA Repeater Group for seeing that the frequency was clear when we needed it.

"The frequencies used in the disaster area were 147.42 simplex, 147.375 repeater to the Cincinnati Red Cross and the 444.9 repeater to the Red Cross as well as the 145.19 repeater for support.

"Again, many thanks for a job well done. The Red Cross indicated that without the amateur communications, the job would have taken a couple of weeks to complete and we did it in two days."

From *RF-Carrier*, monthly publication of the Dayton Amateur Radio Association, April, 1997.

Introducing the Family Radio Service

The FCC created the Family Radio Service back on May 10, 1996, but I've never seen any details about this new unlicensed radio service in *QST*. Why should hams care about a short-range unlicensed radio service closely related to CB radio? Two reasons: (1) over 99% of the people in this country are not licensed radio amateurs and (2) it is illegal to use amateur radio for business communications. Small hand-held transceivers for the Family Radio Service could be used to keep in touch with unlicensed family members or for conversations one couldn't legally conduct via amateur radio. In addition, Family Radio Service transceivers should be relatively cheap, probably about $100.

A total of 14 channels are assigned for the Family Radio Service. These 14 channel frequencies are listed below.

Channel No.	Freq. (MHz)
1	462.5625
2	462.5875
3	462.6125
4	462.6375
5	462.6625
6	462.6875
7	462.7125
8	467.5625
9	467.5875
10	467.6125
11	467.6375
12	467.6625
13	467.6875
14	467.7125

Alert readers will recognize that the first seven frequencies on this list are shared with the General Mobile Radio Service, a licensed radio service that allows a license holder to use up to 5 watts on these seven frequencies, and up to 50 watts on two of eight available repeater frequency pairs. The GMRS repeater frequencies are 12.5 kHz on either side of the frequencies on this list. So why don't people just get a GMRS license instead? Getting a GMRS license involves filling out several pages of FCC forms and paying a $60 license fee.

In an effort to prevent the Family Radio Service users from interfering with GMRS and each other, the FCC imposed fairly tough technical requirements on the transceivers. These technical requirements follow.

Transmitter Power: 0.5 watts ERP
Modulation: FM, 2.5 kHz deviation
Antenna: Integral to unit (no connector)
Frequency Accuracy: 2.5 ppm (0.00025%)

I believe that the first, second, and last items on this list prove that Motorola's lobbyists are smarter than both the FCC lawyers and lobbyists for GMRS interests. Cobra and Uniden America favored somewhat looser standards, but Motorola argued for 2.5 ppm frequency accuracy and 2.5 kHz frequency deviation, standards which require more engineering skill to meet. The reduced frequency deviation and 2.5 ppm frequency stability requirements will tend to keep the Chinese "us too, but cheaper" manufacturers of cordless phones and CB radios out of this market. Motorola also argued for a "tougher" 0.5 watt ERP (effective radiated power) power limit in place of 0.5 watts at the transmitter output to help protect GMRS users from interference. However, considering how inefficient most HT antennas are, I think 0.5 watt ERP is actually a power increase over the 0.5 watt transmitter power the FCC originally proposed.

Anyone wanting more information on the Family Radio Service can go to the source for this article, FCC Docket 96-215. FCC rules for the Family Radio Service are in Part 95.

By George Bednekoff KAØOCN, *PARKing Ticket*, October 1996.

Top 10 Pleasures of Field Day:

10. Fishing bugs out of your coffee cup.

9. Getting lost on the way to the portapotty.

8. Tripping over guy wires and tent ropes in the dark.

7. Discovering that your three-element wire beam for 40 meters, which took all day Friday to erect, is oriented in the wrong direction.

6. Fixing a broken paddle with duct tape.

5. Finding out what happens to a tribander when you drop it from the top of the tower.

4. Having to choose between Field Day operation and your wedding anniversary.

3. The "food."

2. Explaining to your XYL that the YL ops are "just hams."

And the Number 1 Pleasure of Field Day:

1. Getting in the truck to go home and finding that someone has borrowed your battery.

TNX *The Low Down*, the official journal of the Colorado QRP Society. 73

Getting a Taste of VHF

Test drive the bands before you invest in the equipment.

Philip Gebhardt VA3ACK
40 Cameron St.
Ajax ON Canada L1T 2W2
[102515.2604@compuserve.com]

Everyone hesitates to spend a lot of money without first making sure it will be worth it. When you shop for a washer and dryer, you compare features and prices. When you buy a car, you take it for a test drive.

Wouldn't it be nice if you could "test drive" the VHF bands before you invest time and money in the ham radio equipment you'll need to do some serious VHF DXing? That way you could decide if VHF DXing is for you—without making a commitment. You can. Here's how.

The common forms of VHF DX propagation—tropo, sporadic E, meteor scatter and aurora (and F-layer propagation at the peak of the solar cycle)—are not limited to the ham bands. Any VHF signal will be affected by these modes.

And that's what you can capitalize on. Instead of investing money in ham radio equipment to try out these bands, use what you already have. What do you already have on the VHF bands? An FM broadcast receiver and a television set, of course. If you have an outdoor FM/TV antenna, you're in really good shape. A rotor on your antenna is even better—but even without these things, you can get a start on VHF. It's not uncommon to hear VHF DX on an FM car radio.

Many FM (and TV) broadcast stations operate 24 hours a day. Transmitter power is usually in the 25, 50 or 100 kW range. Fortunately, the stations are scattered all over the continent. So, if there's an opening on VHF, you'll hear (and see) these stations.

It's a matter of knowing where and when to listen.

Where?

The "where" part is relatively easy and straightforward. Since the lower VHF TV channels are close to the 6-meter ham band, they are a good choice. (Channel 2 spans the 54 to 60 MHz range; channel 6 occupies 82 to 88 MHz.) Generally, choose the lowest unused channel in your area. If your antenna is rotatable, you may be able to point it away from a semi-local station and create a usable channel.

The FM broadcast band is farther from the 6-meter ham band, but you will still hear the same types of VHF

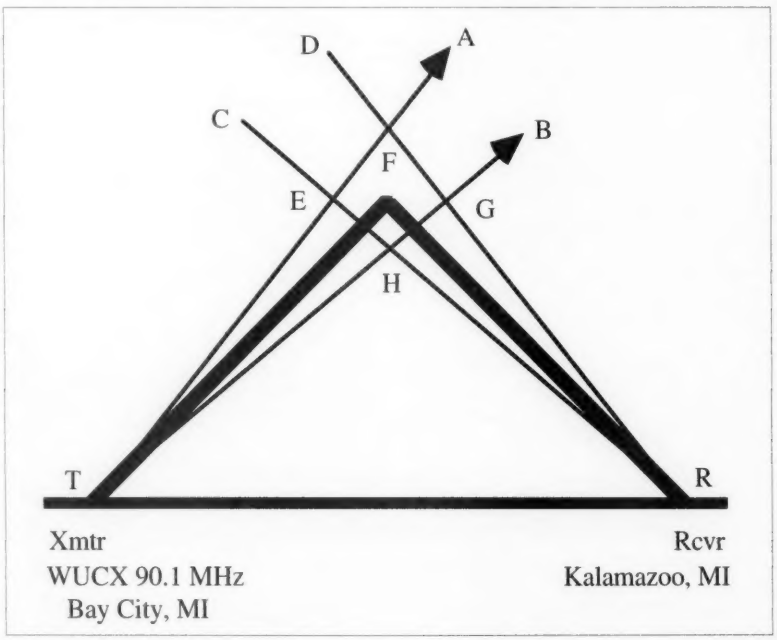


Fig. 1. *Reception distance is often increased by tropospheric effects. Scattering from a common area of the sky is only one way this happens. As in other forms of VHF (and HF propagation), the antenna is aimed at the horizon, not pointed upward. The antenna beam is sufficiently large to detect signals coming in at an angle. In this diagram, the width of the beam from the transmitting antenna at WUCX in Bay City is shown by rays TA and TB. The receiving antenna in Kalamazoo "sees" the portion of the sky bounded by line segments RC and RD. The beams of the two antennas overlap in the region EFGH. If there is an anomaly in this region, signal from the FM station will be scattered and returned to Earth. The heavy line shows the path of a signal being scattered and received in Kalamazoo.*

10 Bands -- 1 MFJ Antenna!

Full size performance . . . No ground or radials

Operate 10 bands: 75/80, 40, 30, 20, 17, 15, 12, 10, 6 and 2 Meters with one antenna Separate full size radiators . . . End loading . . . Elevated top feed . . . Low Radiation Angle . . . Very wide bandwidth . . . Highest performance no ground vertical ever . . .

Operate 10 bands -- 75/80, 40, 30, 20, 17, 15, 12, 10, 6 and 2 Meters -- with this MFJ-1798 vertical antenna and get *full size performance* with no ground or radials!

Full size performance gives you high efficiency for more power radiated. The result? Stronger signals and more Q-5 QSOs.

Full size performance also gives you exceptionally wide bandwidths so you can use more of your hard earned frequencies.

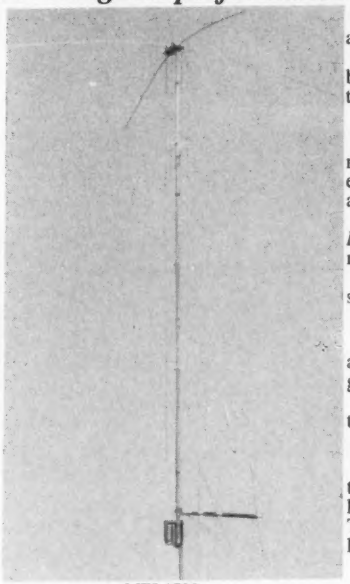
Full size performance is achieved by using separate full size radiators for 2 through 20 Meters and highly efficient end loading for 30, 40 and 75 /80 Meters.

Get very low radiation angle for exciting DX, automatic bandswitching, omni-directional coverage, and low SWR. Handles 1500 watts PEP SSB.

MFJ's unique *Elevated Top Feed*™ elevates the feedpoint *all the way to the top* of the antenna. It puts the maximum radiation point high up in the clear where it does the most good -- your signal gets out even if you're ground mounted.

It's easy to tune because adjusting one band has minimum effect on the resonant frequency of other bands.

Self-supporting and just 20 feet tall, the MFJ-1798 mounts easily from ground level to tower top -- on small lots, backyards, apartments, condos, roof tops, tower mounts.



MFJ-1798
$269.95

Separate *Full Size* Radiators

***Separate** full size* quarter wave radiators are used on 20, 17, 15, 12, 10 and 2 Meters. On 6 Meters, the 17 Meter radiator becomes a 3/4 wave radiator.

The active radiator works as a stub to decouple everything beyond it. *In phase* antenna current flows in all parallel radiators.

This forms a very large equivalent radiator and gives you incredible bandwidths.

These radiator stubs provide automatic bandswitching -- there is absolutely *no loss* due to loading coils or traps.

End Loading

On 30, 40, 75/80 Meters, end loading -- the most efficient form of loading -- gives you highly efficient performance, excellent bandwidth, low angle radiation and automatic bandswitching.

MFJ's unique *Frequency Adaptive L-Network*™ provides automatic impedance matching for lowest SWR on these low bands.

Tuning to your favorite part of these bands is simple and is done at the *bottom* of the antenna.

No Ground or Radials Needed

You don't need a ground or radials because an effective counterpoise that's 12 feet across gives you *excellent* ground isolation.

You can mount it from ground level to roof top and get awesome performance.

No Feedline Radiation to Waste Power

The feedline is decoupled and isolated from the antenna with MFJ's exclusive *AirCore*™ high power current balun. It's wound with Teflon® coax and *can't* saturate, no matter how high your power.

Built to Last

Incredibly strong solid fiberglass rod and large diameter 6061 T-6 aircraft strength aluminum tubing is used in the main structure.

Efficient high-Q coils are wound on tough *low loss* fiberglass forms using highly weather resistant Teflon® covered wire.

Teflon® is registered trademark of Dupont

MFJ *Super Hi-Q Loop*™

MFJ-1786
$299.95

MFJ's *tiny* 36 inch diameter *high efficiency* loop antenna lets you operate 10 to 30 MHz *continuously* -- including the WARC bands!

It's ideal where space is limited -- apartments, small lots, mobile homes, attics, motor homes.

Enjoy both DX and local contacts when you mount it vertically. You get *both* low angle radiation for excellent DX *and* high angle radiation for local close-in contacts. Handles 150 watts.

Super easy-to-use! Only MFJ-1786 *Super* Remote Control has *Auto Band Selection*™. It auto-tunes to your desired band, then beeps to let you know. No control cable is needed.

Fast/slow tune push buttons and built-in two range *Cross-Needle* SWR/Wattmeter lets you quickly tune to your exact frequency.

All *welded* construction, no mechanical joints, welded butterfly capacitor with no rotating contacts, large 1.050 inch diameter *round* radiator -- not a lossy thin flat-strip -- gives you highest possible efficiency.

Each plate in MFJ's *superb* tuning capacitor is welded for low loss and *polished* to prevent high voltage arcing. It's welded to the radiator, has nylon bearing, anti-backlash mechanism, limit switches and a continuous *no-step* DC motor for *smooth precision* tuning.

A heavy duty 1/8 inch thick ABS plastic housing with ultraviolet inhibitors protects it.

MFJ-1782 $269.95. Same as MFJ-1786 but remote control has only fast/slow tune buttons.

NEW!* MFJ-1788**, $359.95. Same as MFJ-1786 but covers ***40 Meter through 15 Meter continuous. Includes super remote control.

Super 80/40M Vertical

MFJ-1792
$159.95

Designed as a *high performance* antenna for 80 and 40 Meters, the MFJ-1792 features a *full size* quarter wave radiator for 40 Meters - - that's a full 33 feet of ruthless radiating power.

End loading -- the most efficient form of loading -- is used for 80 Meters. It's accomplished by a virtually lossless 4½ foot capacitance hat and a high-Q coil wound with Teflon® wire on a *low-loss* fiberglass form.

The *entire length* radiates power.

High strength 6061-T6 aluminum tubing, super strong solid fiberglass insulator, *Frequency Adaptive L-Network*™, heavy duty *swing* mount. Handles 1500 watts PEP. Requires guying and radials, counterpoises or ground screen.

MFJ-1793, $179.95. Same as MFJ-1792 but includes *full size* 20 Meter quarter wave radiator.

MFJ *halfwave* Vertical

6 bands: 40, 20, 15, 10, 6, 2 Meters . . . No radials or ground needed!

MFJ-1796
$199.95

Operate 6 bands -- 40, 20, 15, 10, 6 and 2 Meters -- with this MFJ-1796 *ground independent halfwave* vertical antenna! No radials or ground ever needed!

It's only 12 feet high and has a *tiny* 24 inch footprint! Mount it anywhere from ground level to tower top -- on apartments, condos, small lots, even motor homes. Perfect for vacations, field day, DX-pedition, camping.

Efficient *end loading*, no lossy traps. *Entire length* is always radiating. *Full size* halfwave on 2 and 6 Meters. High power *air-wound* choke balun eliminates feedline radiation. Adjusting one band has minimum effect on other bands.

Automatic bandswitching, low radiation angle, omni-directional, handles 1500 watts PEP. Goes together in an afternoon.

Box Fan Portable Loop

MFJ-1780
$229.95

No, it's not a fan -- it's a high efficiency portable loop antenna that's about the same size and shape as a 2x2 foot box fan, complete with carrying handle.

Carry it like a suitcase, tuck it in a corner of your car or check it as baggage on a plane.

When you get there, set it on a table or desk and enjoy ragchewing or DXing.

All welded construction, covers 14-30 MHz *continuously* including WARC bands, handles 150 watts. Remote control has fast/slow tune buttons. Separate control cable not needed.

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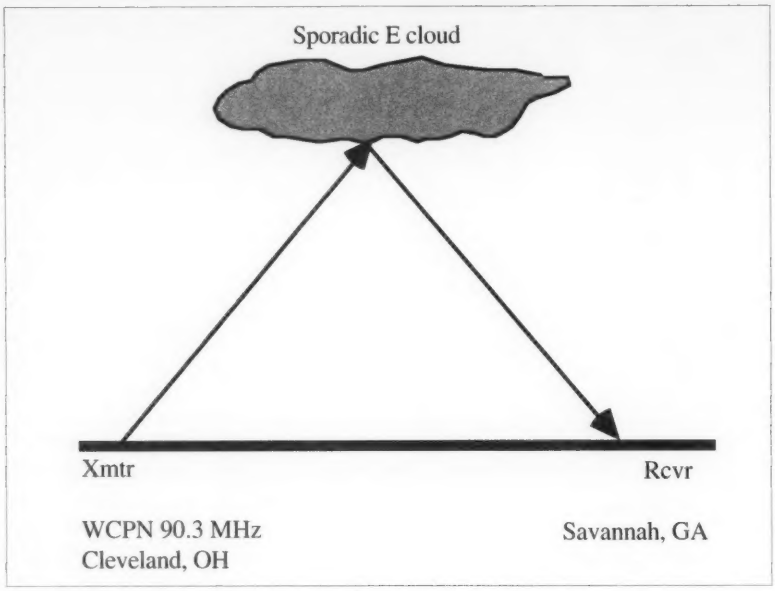

Fig. 2. *Signals are reflected by ionized clouds in the E layer of the ionosphere. Sporadic E signals are strong and may last much longer than meteor scatter signals.*

propagation. There are plenty of tropo, sporadic E and meteor scatter signals to hear on the FM band.

Choose an unoccupied frequency in the FM band for best results. The lower portion of the FM band is occupied mainly by educational and noncommercial stations. Although they may run lower power than the commercial stations higher up, they may cause you fewer interference problems and you may hear a variety of stations come and go on a single frequency as propagation changes.

You will sometimes hear (or see) DX override a semi-local station or even a local station.

Why an unoccupied frequency? Simply because it is easier to detect weak signals that could easily be masked by a stronger station. Also, it's easier to hear a weak signal if there is nothing but noise competing for your listening attention.

It's easy to select an unoccupied TV channel, but there are several things to keep in mind when selecting an FM frequency. Remember that although the FM band covers the 88 to 108 MHz range, the lowest assigned frequency is 88.1 MHz; the highest frequency is 107.9 MHz. Stations on the FM band are spaced at 200 kHz intervals, so assigned frequencies follow the pattern 88.1, 88.3, 88.5, and so on. There are no stations on frequencies such as 88.2, or 88.25 MHz. A receiver with a digital readout makes it much easier to "park" on an unoccupied frequency. If your receiver has a rule-and-pointer dial, you'll need to estimate the frequency.

If you live in a metropolitan area, finding an unoccupied FM frequency can be a challenge. In that case, the best you may be able to do is to listen on frequencies where signals are weak.

If you are blessed with a QTH where you have a multitude of unoccupied frequencies, you'll need to make a decision about where to listen.

You can use several approaches to solve this "problem" (we all should be so lucky as to have it). You can try the hit-and-miss approach: Just pick an unoccupied frequency and listen.

Another approach is to select your listening frequency based on conditions. (This statement will make more sense after the description later on of different propagation modes.) For this you'll need a reference guide such as *FM Atlas*. This annual publication lists FM stations by frequency and by location. It also indicates transmitter power. Knowing transmitter power allows you to select the higher-power, easier-to-hear stations. Transmitter antenna height (also listed) can sometimes be an advantage to know, too.

That covers the basics of where to listen.

Now for the "when" part

"When" is generally dictated by propagation. Many books go into great detail about the various forms of propagation on the VHF bands. You'll also find some excellent articles by looking through back issues of ham radio periodicals (such as *73*). Here

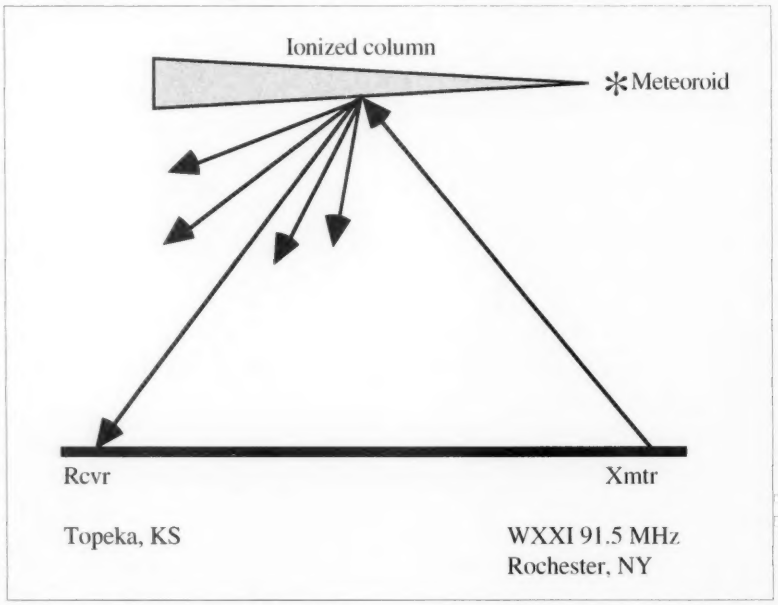

Fig. 3. *Signals are reflected by ionized meteor trails. In most cases, however, the signals are scattered rather than reflected in the general sense of the term. The density of the trail governs the reflection vs. scattering effect.*

are some basics to give you an idea of when to listen and what you are listening for.

Tropo

There are a number of effects within the troposphere that enhance signal propagation. While the common belief is that signals are limited to line-of-sight range at VHF, this is rarely the case with a beam antenna on a tower. Listen to the FM band and record the stations you hear. It won't take long to realize that many of them are well beyond the line of sight. This in itself is a good lesson in VHF propagation (if you don't know how to calculate the distance to the horizon, check the propagation chapter of the *ARRL Handbook* for the formula).

Stations can be heard almost daily using tropo scatter. Both antennas are aimed at a common area in the troposphere. The lower boundary of the area is determined by the antennas in use; the upper boundary is about 10 km (6 miles) above Earth's surface. That's not very high, so signals are limited to about 500 km (300 miles) between the FM station and your antenna. In practice, the distance is usually much shorter than this.

What makes this form of propagation so appealing is its dependability. There is little day-to-day or seasonal variation. If you live near a large body of water—the Great Lakes, the Atlantic Ocean, the Pacific Ocean or the Gulf of Mexico—you can take advantage of temperature inversions. These occur from the evening until the morning hours.

Weather maps in newspapers, on TV or (these days) available on-line via your computer give clues to propagation. Watch for a warm front approaching your area. Propagation is parallel to the front and occurs for several hundred kilometers ahead of the front. Cold fronts also enhance VHF propagation along the front. In this case, the signals propagate behind the cold front. Start listening just after the front has passed your QTH.

Wave cyclones occur in the spring over mid-America and may provide propagation for a day for stations in the northern, southern, eastern and central states.

Slow-moving high-pressure systems, common in late summer over the eastern half of North America, can provide DX possibilities during the evening and early morning hours. Refer to ARRL publications, such as *The Radio Amateur's Handbook* or *Beyond Line of Sight*, for more details.

As mentioned previously, this is a time when you would want to use an FM station guide to select specific stations to listen for. Why waste time listening on 90.7 MHz during an opening along a warm front, if there are no stations within a few hundred kilometers ahead of the front operating on 90.7 MHz?

Sporadic E

You'll see this form of propagation also referred to as E skip, short skip or Es. The term "sporadic E" comes from the fact that the DX openings are sporadic (and therefore not predictable) and that the ionized clouds responsible for reflecting signals are located in the ionosphere's E layer.

In any case, sporadic E occurs most frequently in May, June and July and to a lesser extent in December and January. Listen from 9:00 a.m. to 12:00 p.m. local time and again from 5:00 p.m. to 8:00 p.m. These are the most common listening times; however, sporadic E can occur at any time of the day or year. The opening may last anywhere from a few minutes to several hours.

Because the clouds form suddenly, signals appear quickly. Signal strength is high. The clouds may also *move* quickly so one strong DX signal may rapidly be replaced by another equally strong signal from a different station.

Because of the increased altitude, sporadic E signals have a greater range than tropo signals. Expect distances from 500 to 2300 km (300 to 1400 miles).

An excellent report on an eleven-year study of sporadic E on the FM band appeared in *QST* (May 1992).

Meteor scatter

Yes, those things you see streaking across the dark night sky affect radio waves. The reason is simple: Not only does a meteoroid produce a visible meteor (trail of light) as it enters Earth's atmosphere, it also produces an ionized column.

This column, like the ionosphere, can reflect signals. How effectively signals are reflected depends on the density of

Shower Name	Peak Date (1997)	Peak Time (UTC)	Duration (in days)	Meteor Rate (per hour)
Eta Aquarids	May 4	2200	6	20
Arietids	June 7	0911	2	60
Perseids	August 12	1800	4.6	100
Orionids	October 22	0100	8	25
Taurids	November 5	0124	30	15
Leonids	November 17	1052	4	15
Geminids	December 14	0600	3	58
Ursids	December 22	1145	2.2	10

Table 1. *Data for various showers of interest to amateurs. Each shower lasts for several days, so listen before and after the peak date. The column labeled "Duration" gives an indication of how many days you should listen.*

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the column. About ninety percent of meteor trails are underdense. Underdense trails tend to scatter the signal, hence the term "meteor scatter."

You can hear meteor scatter any time of the day or night and on any day of the year. There is a diurnal variation with a maximum occurring around 6:00 a.m. local time and a minimum occurring at 6:00 p.m. The ratio of maximum to minimum is about 4 to 1. You may hear a few to a few dozen per hour around 6:00 a.m. This is the pattern for sporadic meteors (meteors produced by meteoroids that travel alone).

Since both the time of arrival and direction of sporadic meteors is unpredictable, you can simply point your antenna south in the morning, select an unoccupied frequency and listen.

At predictable times throughout the year, you can hear an increase in the number of reflected signals. This occurs during meteor showers. Probably the most famous shower is the Perseid shower that occurs in August. During a meteor shower, Earth passes through a large number of meteoroids traveling in highly correlated orbits. Depending on the shower (and your listening setup, of course), you can hear several dozen to several hundred signal reflections per hour. There are even daytime showers that can only be detected by radio means.

"It's a matter of knowing where and when to listen."

Refer to an annual astronomy book (such as Royal Astronomical Society of Canada's *Observer's Handbook*) or a periodical (*Sky & Telescope* and *Astronomy* are available at newsstands) to find the dates for showers. **Table 1** will get you started.

Timing and antenna direction are more critical with showers than with sporadic meteors. You can try the probe method (listening for signals to peak as you rotate the antenna—not very effective in this application), or you can read the VHF manuals for hints. Computer programs are available to calculate peak times and corresponding antenna directions. Check your favorite ham radio BBS or on-line service.

You might think that you need to point your antenna upwards. That is not the case. Point your antenna at the horizon to hear signals reflected by meteors. This approach will yield the greatest distance.

Because meteoroids ablate at an altitude comparable to the E layer of the ionosphere, distances will be comparable to sporadic E signals.

Now, for what you'll hear: Assuming that you are listening on an unoccupied frequency, most of the time you'll hear mainly receiver noise. Periodically, you'll hear a signal rise out of the noise very rapidly. As soon as it peaks, the amplitude will start to decrease. The signal may last for a fraction of a second or for several seconds depending on the meteor. There may also be a residual signal beyond this time.

That's it, folks

No station IDs, no complete songs, no entire weather forecasts. You'll be lucky to hear a few notes of a song or a few syllables (maybe words) of a news report.

Why do people put themselves through this agony? Sporadic meteors are basically practice. The real fun comes during meteor showers because there are so many more meteors. During a shower, you hope for several meteoroids coming into the atmosphere in succession so the signal lasts longer as it reflects off successive meteor trails.

The advent of computers and the use of packet techniques by hams makes signal exchanges much faster (and therefore more successful) than previously possible. So, if you like listening to meteor scatter on the FM band, you'll probably really get excited when you hear it on the ham bands.

Aurora

Signals can also reflect off the aurora. However, the number of opportunities you have to use this form of propagation depends on your latitude. The farther north you are, the more opportunities you get—but it's a little more complicated than that. Auroral propagation depends on geomagnetic latitude. Rather than following those neat lines of latitude that appear on maps, geomagnetic lines slope from

northwest down to southeast. As a result, DXers on the east coast have an advantage.

Auroral propagation is cyclic. There is a seasonal pattern with more opportunities at the equinoxes (March and September). There is also a cycle that may be related to, but not in phase with, the solar cycle. Peaks occur about 2 years before and after the solar cycle maximum. The diurnal pattern indicates two strong peaks—one at about 6:00 p.m. local time and a second around midnight.

Best signals are heard by pointing your antenna in a northerly direction, but probing for the best signal is important.

Predicting auroral conditions on VHF is a matter of listening for the signs on lower frequencies and waiting for the effect to reach the VHF range. Wavering signals that are weak and sound watery on the AM broadcast band up through the 40-meter band in late afternoon or early evening are a sign that auroral conditions are developing. Station WWV broadcasts A and K indices at 18 minutes past the hour; WWVH does the same at 45 minutes past the hour. A K index greater than 5 and an A index greater than 30 indicate that it's time to listen for auroral activity.

Keep in mind that you may not see the aurora, but you may still be able to hear signals via this form of propagation.

This is only the beginning. There are other forms of VHF propagation as well as variations on the ones mentioned here and even combinations, such as auroral E.

If you find that VHF DXing on the FM broadcast band has whetted your appetite, you are a prime candidate for DXing on the VHF ham bands.

By the way, most of the forms of propagation present on VHF also occur on 10 meters. Yes, you can use your HF rig to have sporadic E QSOs; try your hand at meteor scatter work; and make contacts via the aurora. While sporadic E is exploited on this band, meteor scatter and auroral propagation go virtually unnoticed. You will need to pursue these openings with a like-minded ham.

All things considered, DXing on the FM broadcast band (or low VHF channel TV) is an excellent introduction to the world of VHF. 73

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CIRCLE 186 ON READER SERVICE CARD

Horsetrading on the Ham Bands

The FCC has approved on-the-air buying, selling and swapping ham gear via the traders' nets.

Ronald Lumachi WB2CQM
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Only a short while back it was really a pain to advertise amateur radio gear for sale or to draft the text of an advertisement for an item that you wanted. You had to write the ad, send it along to your favorite media source, and then wait weeks (sometimes months) before it finally arrived in print. By that time, the event was somewhat anticlimactic—often if an individual did call in response to your advertisement, you'd have to be reminded about the details. Hams, being an impatient (but most resourceful and proactive) lot, recognized the shortcomings of this process and began meeting in their on-the-air cliques to discuss what they wanted to buy, sell, or swap. Increasingly popular, these informal groups evolved into more structured, regularly scheduled occasions, attracting larger and larger numbers of participants. Although the nets sport a variety of names, including Horse Traders, Old Gear & Junk, Collins Net, etc., they all afford the radio amateur the opportunity to offer his/her wares on the air, without delay, to a large number of knowledgeable, attentive, and motivated buyers and sellers—and the best thing about it is that the free service is instantaneous. If it sounds like a good deal, it is. Its success can be traced to the tireless efforts of the radio amateurs who are the net controllers. Their unselfish dedication and perseverance make the service possible.

How does the net work?

The organizational rules are simple and straightforward and are generally applicable to any of the traders' groups. Usually when the net is called, the controller briefly reviews the regulations governing its operation. The FCC has allowed hams to advertise over the air provided they meet minimum criteria. [See Part 97.113 (a) (2) of the Regulations for prohibitions and exceptions to the sale/trade rule.] Obviously, the controllers are in the best position to enforce the regulations to the letter of the law since the FCC, because of its manpower and budget shortfalls, has of necessity directed its attention to more pressing matters.

The first and most important admonition is that commercial advertisers are not welcomed. In addition, anyone who has been identified and proven to be (to the satisfaction of the controller) a full-time purveyor of radio gear is told he/she is in the wrong place and asked politely to move on. Third party listings are not permitted but their wants are OK. Any equipment offered must be in the seller's possession. This situation arises frequently when there is an estate sale and a ham, as a special favor to the widow, offers to liquidate the gear. If that's the case, it's easy to conform to both the spirit and letter of the law: Have the gear in the shack when advertising. Net controllers are aware that FCC regulations allow on-the-air sale or trade of any equipment provided it is ham-radio-related. They make a conscientious effort to conform closely to that ruling. To illustrate this point, I recall in one instance an individual offered an aviation-type GPS (satellite positioning) unit and an altimeter, ostensibly to locate and accurately measure the height of one's QTH. He was politely reminded that offering that equipment was stretching the rule a bit too far and was politely directed to hit the road! Computers are accepted on the general equipment nets provided they support some aspect of packet operation. Oddly enough, scanners can be listed with impunity.

A seller may quote a price for an item, but any negotiations, haggling, or plain horsetrading must be accomplished over the telephone. On many occasions, the seller may be asked by someone (through the controller by signaling with the word "contact" and being recognized) to clarify the listing with additional details that may have been omitted. For example, before placing a long distance telephone call, an individual may want to know the serial number of the rig, the number of filters in a particular receiver, or whether the linear is a two-holer or capable of tuning 160m. It's the seller's option to include or omit the asking price. He may prefer to discuss the details more privately over the telephone. One experienced trader mentioned to me that he never calls when a price is not listed. He claims they are invariably too high. If you think it's a worthwhile deal or you need more specific information, make the call. It's important to remember that the nets are "directed," so all inquiries must be channeled through the net controller. Imagine the resulting chaos if it weren't handled in this manner. The controller's task is difficult, to say the least, and virtually impossible to undertake without a first-class radio station, a high degree of personal fortitude, the patience of a saint, and the endurance of a marathon runner. The majority of net controllers maintain a running log of those checking in, including telephone numbers and equipment offered. Some, less technological than others, use their own special

shorthand and keep paper notebooks to record the entries. Others use computers and maintain databases from week to week. Net controllers are routinely asked to search out a previous listing (usually with success) based on very sketchy information. They do it gladly and pride themselves on the sophistication of their logging systems. Most frequently, telephone numbers are incorrectly copied by prospective purchasers (QRM, QRN, QSB) and when queried the controller has the capability to check back into the log and set the record straight. It's not an easy task by any stretch of the imagination, especially when 100+ hams check in with 400–500 bits of discrete information.

How do you participate?

Check the accompanying listing for the net time and frequency that offers you the most consistent propagation. Bands are often noisy and crowded, so listen to those groups that produce the best signal strength to your locale. Interference is often generated in unusual ways. For example, (although it's difficult to explain the motivation) there are occasional incidents of malicious interference from QRMers whose sole purpose is to disrupt the net. Controllers continually remind net participants that they should not get bent out of shape and feed into those guys by acknowledging their presence with speculations about their mental health or family lineage. Past experiences have shown that this passive response works well since those interfering usually get tired and simply fade away. To a lesser extent, overzealous contesters must be continually directed away from the frequency; they usually respond with a quick apology to the controller and an immediate QSY.

Most nets begin promptly and follow a sign-in protocol. Generally, the net controller will accept the suffix of your call in alphabetical order usually beginning with "A." For example, in my instance, I would sign in when the "C"s are called with "CQM." If the controller copied my signal he would acknowledge that I was on the list; if not, I'd try again. If my signal were marginal due to poor propagation to the controller's QTH, I'd ask for a relay. Someone would hear my request and offer to forward the message. Incidentally, mobiles get first

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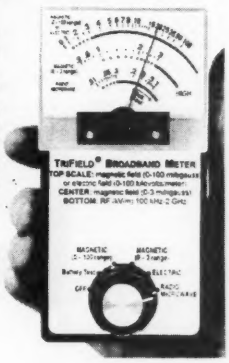

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CIRCLE 341 ON READER SERVICE CARD

crack at listings. Remember the cardinal rule—*You've got to be on the list to participate!* The hams with the suffix "A" are not always the first to go. Controllers reverse the alphabetical listings weekly. If "A"s were first last week, they're last the next time around. It's the amateur with a callsign in the center of the alphabet who never gets to the head of the line, but there are seldom complaints from anyone. Imagine the confusion if you started at the middle of the alphabet and worked in both directions. On many occasions, the controllers, prior to taking the regular listing, will liven up the sign-in period by calling for a pileup and listening for the loudest station. It's truly organized chaos, but if your callsign is recognized above the cacophony of signals, it's quite an ego trip for the participant. I'll wager there aren't too many hams around who don't want the world to know that they're top banana. It's good fun and enjoyed by all. As a reward for the outstanding five or six of the best signals, the big guns are allowed to list first. It's a small enough compensation for tweaking that antenna, cranking up (sometimes a little above the legal limit) the amplifier, and consuming a bit more electricity. It's an interesting side note but many of the big boys with giant signals accept the accolades and then politely pass on the option to list. They just revel in the recognition and ego-boosting action.

In many cases, the net controller can gauge the length of the net by the number of check-ins. If the list of participants is overly long, it may be decided to limit each trader to a specific number of items. Usually it's never less than four (any combination of buy/sells). If the list appears to be shorter than usual, he may announce that time will be allotted at the completion of the net for latecomers. Pay particular attention for that announcement in the event you arrived too late and the controller has passed you in the alphabet. You'll only get one shot at logging on.

For a variety of reasons, it's a good idea to listen closely to the net rather than become preoccupied at the other end of the house. First and foremost, you won't miss your turn. While listening, you may locate a particular item being offered that is of interest to you. This is especially true if you planned to list a "want" and the item fortuitously appears. More importantly, when you're focused on the listings, you begin to get a feel for the going price of a particular piece of gear. Remember that the "educated" ham will neither pay too much nor ask too little for equipment, provided he/she has done the homework. If you listen for only a short time, you're certain to get the rhythm of the net.

When your turn comes, sign on with your full callsign, handle, and referenced location if you do not live in a city with a recognizable name. In my instance, Greentown (my second station) would have little impact on anyone (except a local amateur, the deer, and perhaps the resident chipmunk) until I indicated that it is situated in northeast Pennsylvania, 20 miles east of Scranton. Because of the high profile of the Big Apple, there should be no problem of location if I'm listing from my (primary) New York City QTH.

"A full-time purveyor of radio gear is told he is in the wrong place and asked politely to move on."

State the items you have for sale (or announce your needs) and be as comprehensive and honest as you can be with this description. Generally, the 1–10 scale is used to evoke an image of condition. For example, a 9+ with a minor scratch on the top cover would indicate that it's close to factory condition but has a surface blemish. Make certain to include all accessory items that will affect the price. For example, what is the serial number? Are there extra crystal filters for the receiver? Do you have the original manual and shipping cartons? Does it include the power supply? Is there an auto antenna tuner? Is there full output on the linear? Are there any spares? Will you ship the item, and does the price include shipping? Does the speaker have a built-in phone patch? Or, with heavy items, would you travel a reasonable distance to meet someone?

Don't be reluctant to advertise a junker, but make certain that you clearly identify what you're offering. Many hams need discrete parts for a restoration or rebuilding project, and what you offer may fit their needs perfectly. To ensure that you've made your list both complete and comprehensible, write down the text of the ad beforehand. Don't try to ad lib. You'll either stumble along and embarrass yourself or leave out a vital part of your message. You'll kick yourself afterwards when you realize why the telephone hasn't rung. It happens all the time, even to the most confident trader. You may, if you wish, state an asking price and indicate if you are amenable to trading for a specific item. If you feel that the trades are not of comparable value, don't hesitate to mention that you are aware of the price difference and willing to offer (or take) an appropriate amount of cash to smooth out any rough spots.

Make a conscientious effort to avoid extraneous comments. Stay focused and leave the chit-chat for another time. Sellers make this mistake all the time. It takes up valuable net time, obscures the message, and generally confuses everyone. Above all, avoid trying to hustle the group by overpricing. Rest assured, the traders know what an item is worth and they don't want to pay for your emotional attachment. You'll know exactly what I mean when you hear a symphony of polite whistles in response to an unrealistic asking price. If that happens to you, you're usually dead meat! Keep to your script and sign out by listing your telephone number twice (slowly) along with the area code, repeating your name phonetically, and listing your callsign. At this point you may offer your E-mail address to those who would prefer to contact you that way.

If you've struck a chord with someone in the listening audience (a hot item at the fair price), expect a telephone call even before you sign off with the net controller. Be prepared for bargaining, but if you've done your homework you're aware of fair value. Feel free to be firm on the price and to reject any unrealistic offer. On the other hand, remember that everyone loves a bargain, so if you're close in price, consider compromising a bit and making the deal. If there's no meeting of the minds, take the caller's telephone number in the event you later

determine that the offer at hand is the best (or only) one received. It's amazing how much better an offer looks when no one else calls. If you've struck a deal, then serious talk should begin. I'd suggest you ask for payment in the form of a postal money order or send the items COD and specify payment to be made in cash. This will eliminate any surprises down the road. It's common practice and not a disagreeable or expensive method to close a deal. Don't forget to jot down the name of the person, callsign, and the telephone number. You may find it necessary to contact that individual at a later date.

If it sounds like a done deal, look for shipping cartons (liquor stores are a good source) and some good packing material during that period when the check is in transit. It's always a good idea to double-pack the component using two containers. Shipping companies are notorious for damaging equipment, so you've got to make it as difficult as possible for them to destroy your treasure. If you are thinking about shipping used equipment with Uncle Sam, keep in mind that the post office usually does not pay off on insurance claims without a battle. Get back on the net to announce your deal as soon as you hang up the phone. Many controllers encourage "rechecks" from sellers to announce that a sale has been made. They will delete the sold item from their computer or simply cross it off. A recheck can also mean someone saves a long distance call. However, if you do happen to get that extra inquiry, take the name and number for reference. On occasion, the money simply never materializes and the buyer doesn't have the courtesy to telephone about the change of heart—so don't hesitate to call the second interested party and make your deal.

What's it worth?

If you haven't spent too much time on the net, it's sometimes difficult to determine what to charge (or what to pay) for a piece of gear. Listen around a bit and hear what's being offered, at what price, or contact one of the controllers prior to the net and ask the going rate for a particular item. Their response, based on experience, is usually on target with prices. If the item you're offering is current production and in mint condition, figure on about 50–60% of the manufacturer's list price as a good starting point. Prices must be adjusted downward if it has flaws and is not up to factory specs. All bets are off if it's an antique and in high demand. Just try to buy a set of original CW and AM filters or a speaker for a Collins 75A4! These discrete components, available a short time back for peanuts, now cost almost as much as the receiver itself. In any event, you'll want the best deal you can get, so if you're not certain, check around. Ask around both before and after the net for the information you need. For many of the regulars, the trader's group is also a social event and they're found around the net frequency with their cronies sharing trading experiences and prices. Don't be reluctant to ask one about the value of a piece of equipment, since most hams are more than anxious to share their expertise.

"Listen around a bit and hear what's being offered at what price."

What's the downside?

Dealing at arm's length (not eyeball-to-eyeball) for an expensive item may be a nightmare waiting to happen. Net controllers are quick to remind participants that they are *not* responsible in any way for the transactions that take place on the net. As part of their disclaimer, they suggest that the involved parties attempt to resolve any dissatisfaction resulting from a sour deal. (You can see the importance of having a clear and written understanding of the transaction details should an item prove not to be to your expectations.) Generally, refunds are made by the seller with no questions asked.

For example, I recently purchased three Collins A4 mechanical filters for a newly-acquired receiver which was at that time away for extensive surgery courtesy of Howard W3HM. The deal was that the money would be refunded if the filters did not work. Four months later, the receiver was returned (with the front end sensitivity hotter than a firecracker); the filters were tested, and one didn't work. I sent a note to the seller in Pittsburgh and within a couple of days

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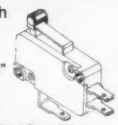

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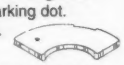

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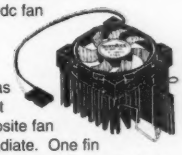

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received a refund. How's that for honesty and integrity and a tribute to the net participants?

Although problems are few and far between, situations do arise that require third-party intervention. In some instances, where the buyer and seller are at an impasse, the controller may intervene, determine the facts, and suggest a solution. On extremely rare occasions, there have been alleged instances of outright fraud and misrepresentation. If that's the case, take your postal money order receipt, canceled envelopes with all pertinent correspondence and visit the local postmaster. State your case, present the evidence, and learn whether the mails were used to defraud. Sometimes, a visit or call from the postal authorities can move mountains. If you've successfully identified an individual as a villain, get back to the net controller as quickly as possible with the details. That information will be put into the computer and a general announcement made to the net participants. In addition, the scoundrel may be denied further net privileges until the incident is resolved. It's a powerful and persuasive tool and I can assure you the word gets around, since most horsetraders have excellent memories and frequent many of the nets.

It never ceases to amaze me how few complaints are reported to the controllers as a result of a bad deal. This is certainly a tribute to the amateur radio fraternity and its generally high-principled individuals. This particular group loves to trade and they relish the art of the deal—they are careful to describe their wares accurately, and astute enough to price them realistically. If you're really fortunate, you'll locate the item you want from a ham across town. If you like what you see and it performs acceptably, pay the money and cart it home. Unfortunately, this is not the usual scenario, so, in the used gear arena the arm's-length deal remains a viable option. Prepare well in advance and have all of your "what-ifs" covered. Make up a memorandum of agreement, especially if it's a big ticket item. List as simply and succinctly as possible the description of the equipment and the terms of the deal. State clearly that money will be refunded if expectations are not met. Prepare two copies of the agreement and have a place for dates and signatures.

Still skeptical?

Thousands of deals have been consummated through the nets, so rest assured that the method works. Don't be overly apprehensive or hesitant to give it a try. You might even test out the system and gain some confidence by purchasing a low-priced item. When the package arrives, open the parcel immediately as the delivery driver stands by. Document the existence of any problems and file your claim without delay. If you're still a bit leery about dealing with someone a goodly distance away, check for horsetrader activity on the local VHF/UHF repeaters. If you can't locate an active group, suggest the idea to the club officers and perhaps consider being the net controller—most hams have a little horsetrader in them. I guess it's in the genes!

Acknowledgments: Special thanks to two gentlemen, net controllers Evan K9SQG (Sunday 7275 kHz 0930 EST) and Bill KJ8I (Monday 3898 kHz 1900 EST), who contributed net controllers' insight and perspective to this article. Dave WA3GIN, a dedicated horsetrader with a sense of humor, allowed me to include his E-mail comments on my note outlining some of the material being included in the article.

Dave wrote, "Yeah...make sure you talk about the folks who want new, in-the-box-with-the-manual, one-owner, non-smoker, guaranteed mint-condition, double-boxed, shipped UPS, but are willing to pay 1/10 the list price of the equipment, and of course the seller pays the shipping." 73

Net Operation Protocol

Log in by callsign *suffix* alphabetically at the net's outset. If time permits late check-ins are listed.

Prices of items being offered may be listed; however, any negotiations are by "twisted pair."

Prices need not be offered on the air at listing time.

A request for a specific item is OK.

Equipment must be in the lister's possession. *No third-party offerings!*

Condition should be honestly represented (scale 1-10) with any pertinent discrepancies noted.

Schedule of Traders' Nets (all times EST)

Monday	7:00 p.m. (0000Z)	3898 kHz	General equipment (packet related computers OK)
Tuesday	8:00 p.m.	146.880/280	General equipment (NYC area)
Wednesday	10:00 a.m.	7251 kHz	General equipment
	8:00 p.m.	3945 kHz	
	8:00 p.m.	3865 kHz	
Thursday	6:30 p.m.	3875 kHz	AM equipment (sideband check in OK)
Friday	8:30 p.m.	3870 kHz	General equipment (Texas)
Saturday	8:30 a.m.	3985 kHz	General equipment
	10:00 a.m.	7275 kHz	Old gear/amplifiers/components
	8:00 p.m.	3865 kHz	Drake and other older tube-type radios
Sunday	9:00 a.m.	7275 kHz	General equipment (two consecutive sessions run)
Note: At the completion of this Sunday session, there is often a computer net.			
	12:00 p.m.	14.317 kHz	Icom Net
	3:00 p.m.	14.363 kHz	Collins Net
	5:00 p.m.	14.275 kHz	Heath (not confirmed)
	5:00 p.m.	3942 kHz	General equipment
	8:30 p.m.	3922 kHz	General equipment

Build the Mag-Glass

Combine the best of the through-glass and the magnetic-mount antennas.

David K. Pelaez AH2AR/5
7309 Centenary Drive
Rowlett TX 75088

I had pondered, long and hard, on an antenna mounting system that utilized a through-glass type antenna—one that could be easily removed and remounted.

One type of commercially-made system I'd seen was a flat spring clip that connected the coupler and the through-glass antenna together, hinged like a clamshell. The problem with this system was that it required the through-glass antenna to be placed near the top of the window because the clip was designed to ride over the edge of the rolled-up window glass. Not only does this design limit your mounting options, it also brings the radiator very close to the gutter and roof.

Why not just use a "standard" magnet-mount antenna, and mount the antenna to the roof or trunk lid? This option also has its limitations. Magnets do not adhere to Fiberglas™ body panels, and magnet-mount antennas, even with rubber boots, will scratch the clearcoat or paint of the car if you aren't careful.

Photo A. *The petal-shaped rare earth magnets, used after the creation of the original design.*

New ideas

Someone once said that there is no such thing as a new idea; new ideas are just the synthesis and combination of old ideas. I knew there had to be some way to attach a through-glass antenna to an automobile window so that it wouldn't be necessary to pry the coupler and antenna off. Normally, through-glass antenna systems come with sticky pads on the coupler footprint and the antenna pad footprint. Once the pads are applied to the opposite sides of the glass, prying them off the window means replacement with new sticky pads. For temporary use, that's just not practical.

"Once centered, these magnets had a grip like a gorilla!"

Searching the junk box produced six neodymium iron-boron magnets I'd purchased several years earlier at Midwest Surplus, in Fairborn, Ohio. Rare earth magnets are used in high-efficiency generators and precision high-speed/high-torque electric motors.

Initially, I was amazed at their magnetic strength, and thought at the time that they might be useful for holding glued wood laminates together to support a woodworking project. They are, far and away, stronger than any conventional magnet available, and as I found these magnets were strong enough to stay in place on opposite sides of wood laminates up to three-quarters of an inch thick, I tested their strength on automobile glass and was equally impressed when I sandwiched the glass between two of these magnets. The magnets came together with a muffled snap, and I spent the next minute or so trying to remove them from the glass. Once centered, these magnets had a grip like a gorilla! My through-glass antenna problem had been solved.

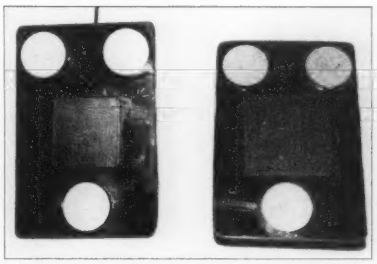

Photo B. *The glass-contact side of the Mag-Glass baseplates.*

Materials

The through-glass antennas used in this project are two-meter and 900-MHz antennas from Valor. Of course, any type of through-glass antennas should work. The Valor design has a fairly symmetrical base and I found their basic design makes cutting the Plexiglas™ I purchased at a hardware chain store relatively easy.

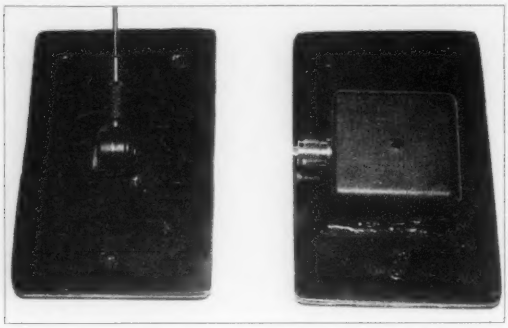

Photo C. *Baseplates with epoxied antenna pad and coupler. The Plexiglas was painted black after construction.*

Prototype #1 was made with 1/4-inch Plexiglas. The second prototype was made with a thinner 3/16-inch Plexiglas. Either of the two thicknesses will work, but my preference is the lighter 3/16 inch. I used a Dremel™ drill with a cutting bit to countersink the magnets into the Plexiglas. A barrel or cylindrical rotary file bit works well in routing out the Plexiglas (be sure to wear eye protection when routing out the holes). Slow-cure epoxy forms a bed for the magnets and holds the coupler and antenna base in place.

For this project, I used quarter-sized Neodymium iron-boron magnets (whose source has dried up), but equally strong and slightly larger Neodymium magnets are now available surplus through Marlin P. Jones and Associates (ordering information at end of article). Their magnets are not round—they are petal-shaped (**Photo A**).

You'll need twelve magnets for this project: three magnet pairs in each Plexiglas baseplate. The magnets are paired, then mounted and epoxied as single units into the Plexiglas. The dimensions and magnet placement shown are approximate, and not critical. The three magnets are placed in a triangular configuration; this placement seems to be the best orientation as it allows mounting on both flat and slightly curved glass surfaces.

Cutting

A coping saw, bandsaw or scroll saw can be used to cut out the rectangular baseplates. Once you have cut out two baseplates, lay out the antenna coupler and the magnets in the configuration shown in **Photo B**. Using a sharp scribe or awl, scratch/trace the magnet and coupler outlines on the Plexiglas. If you are using the Valor through-glass antenna, pry off the rubber boot that hugs the circumference of the antenna pad. Once you remove this rubber boot, the antenna pad footprint will be slightly smaller than the coupler footprint (**Photo C**). This will not affect antenna performance. To hold the magnets in place for the tracings, you can use the other three magnets.

Be sure that both Plexiglas baseplates are configured so the magnets and coupler/antenna pad align when placed together. Once the tracings are done, remove the magnets and coupler, and countersink holes for the magnets and coupler.

"Please remember to slide the opposing baseplates away from each other—never try to just pull them apart."

Using a high-speed drill with a cutting bit, cut a pilot hole into the Plexiglas, about 3/32" deep (the depth of a single unpaired magnet). Use this hole as a depth guide for routing out the interior cavity for the magnet. Follow the tracing, and after completion, check to see how the magnet fits into the depression. Be careful if the fit is tight—it might be difficult to remove the magnet if you cut *too* accurately.

Now cut out a square hole for the coupler and the antenna pad; this can be done with a rotary file on the drill. Make a rough cut with a coping saw, and finish the sides of the cut with the drill. The coupler and antenna pad will be placed into the Plexiglas assembly so they will butt up against a glass surface, so they must be able to pass through the Plexiglas baseplate. A tight fit is desirable, but not essential. Before gluing the coupler and antenna pad, the magnets must be glued and pressed into their wells.

Photo D. *Mounted prototype #1, stuck tight and working great.*

Gluing

The magnets come from the supplier in a stack. I am not exaggerating when I say that it will take muscle to separate them into six pairs. You may find it easier to slide them apart by pushing them against a counter- or tabletop. Once you've got them separated make sure they stay that way by putting a buffer (scraps of Plexiglas, cardboard, etc.) between them. If they accidentally snap together, the force of impact can be enough to cause damage.

With a small drill bit, centered over the magnet depression, drill a small "weep hole" through the baseplate. When epoxy is loaded into the depression, this weep hole will allow some epoxy to escape when the magnet is bedded into the depression.

Check the magnets' mating to ensure that north-south polarity and magnet orientation are correct before gluing. Otherwise, the magnets will repel instead of attract when you try to put the baseplates together. Once the magnet pairs are glued and bedded into the Plexiglas, there will be a 3/32" space between the baseplate and the window surface. This 3/32" is the height of a single magnet that will be protruding from the well. The magnets will be riding on the surface of the window; as long as they are free of iron filings or other magnetically attracted debris, the smooth-coated magnets will not scratch the glass. Before you proceed with gluing the coupler and antenna

pad on their baseplates, be sure the paired magnets are glued and pressed into their respective wells.

The coupler and antenna pad

Once the bedded magnets and epoxy have dried/cured, it is time to glue the coupler and baseplate. Put the baseplate magnet-side-down on a smooth flat work surface. Push the coupler in from the top of the baseplate until it touches the work surface. Run an even bead of epoxy around the top edge of the coupler where it enters the baseplate. To keep the epoxy from oozing out between the coupler and the side of the cut-out baseplate before it sets, I found that coax sealant, available at electronics hobby stores, is a good temporary fix. Before gluing, keep the coupler aligned. Make a very small "rope" of coax sealant and put this material in any open gaps between the coupler and the baseplate to act as a removable dam.

The antenna pad is glued in the same manner, but I opted to fill the top of the antenna pad with epoxy as it sits a little differently from the larger coupler. The antenna pad, being physically thinner and smaller than its coupler mate, sits inside the Plexiglas baseplate in a well. I filled the well with epoxy, and also dammed the other side with coax sealant (once the epoxy cured, I removed the sealant).

Tips

Once the epoxy is completely cured it's time to try the antenna system out (**Photo D**). When placing the baseplates on the surface of the glass, put the opposing baseplates about six to eight inches away from each other on the glass and then slide them together. To remove your antenna from the vehicle, slide the baseplates apart; don't try to pull them apart. *Caution! Never put them on a metal surface*. If it is a painted surface, you will most assuredly scratch the paint. Do not place them on the hood or roof prior to installing them on the glass. The rare earth magnets are very strong—their attraction for metal surfaces is incredible, so be careful. When the antenna is mounted on the vehicle, follow the steps the manufacturer recommends for tuning. I have noticed that once the antenna is tuned (if the antenna is tunable—some through-glass antennas aren't), minor differences in glass thickness or antenna placement have little or no effect on VSWR.

What manufacturers don't tell you

Be aware that there are a number of newer automobiles with "passivated" glass. This glass tinting is created with a metallized spray process called "sputter coating," and is usually bronze- or silver-colored, but is available in a number of dark tints. This tinting process bonds a very thin layer of metal to the surface of the glass, and one of the unfortunate side effects of the coating/tinting is that it is RF opaque, which means radio frequency energy has a difficult time passing through it, and in some cases, can attenuate an RF signal by as much as 30 dB. Cell phone through-glass antennas, or any other through-glass ones will be attenuated when passing through this type of glass. Shifting to a different window, one that doesn't have the tinting, will solve the problem, but switching antenna locations would be a whole lot more difficult if you had used a permanent-mount through-glass antenna.

Storage

When storing this antenna after use, make sure you don't put the two baseplates together without a buffer of some kind—you can damage the Plexiglas or even pull a magnet out of its bed with the strong magnetic force. It is also not a very good idea to store this system near your priceless 3-1/2 inch floppies, or set it on top of your computer's hard drive.

If you want to keep the cost of this project down, one approach is to use six magnets instead of six pairs. I feel that the extra strength provided by the pairs pays off in security, though. They'll hold tight through the thickest automotive glass.

In researching the cost of new rare earth magnets, I found that they would cost about $40 *each* if bought singly from a company in Dallas. Surplus Neodymium iron-boron magnets are available by catalog from Marlin P. Jones and Associates. The part number is 7454-MG, and they are priced at $1.40 each. Call toll-free (800) 432-9937. 73

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- adjust the scanning rate and signal drop wait rate
- scan up or down frequencies using increments you select
- scan frequencies using a frequency list you can build
- divide your frequency list into categories (i.e., ham repeaters, police, fire, business, paging, hospitals, MARS, etc., etc.)
- survey within a frequency range to create a file of active frequencies
- create a packet control program to monitor a frequency and at times transmit a beacon on other frequencies letting the world know what frequency you are monitoring
- temporarily lock out frequencies while scanning (some digital pagers are annoying!)

... and on and on and on—all limited by your imagination and programming skills (if you "roll your own").

Intrigued? Then read on to see how you can build the IBM-PC computer interface that connects between your transceiver and PC parallel port.

Fig. 1 shows the interface circuit built on a Radio Shack™ 276-150 prototype board mounted on top of the transceiver's adder chips (U7 through U10). **Fig. 1** also shows a computer cable running through the modified transceiver power inlet and the necessary connections between the interface and the rig's main board. The other end of the computer cable connects to your PC's parallel port. **Fig. 2** shows additional mounting details using leftover cable insulation as legs and one corner resting on top of crystal Y2, held in place by twisted insulated telephone wire to the RECV bus wire.

The schematic (**Fig. 3**) shows the connection between the PC parallel port and the interface and another connection between the interface and the transceiver. **Table 1** shows the structure of the parallel ports from a programmer's viewpoint.

Central to the interface circuit are U1 and U2, the MC4094 or MC14094. Each chip is an eight-stage shift/store register with three state outputs. A 4094 chip has four inputs and 10 data outputs. See **Fig. 4** for the chips' pin layout. Outputs Q1 through Q8 are

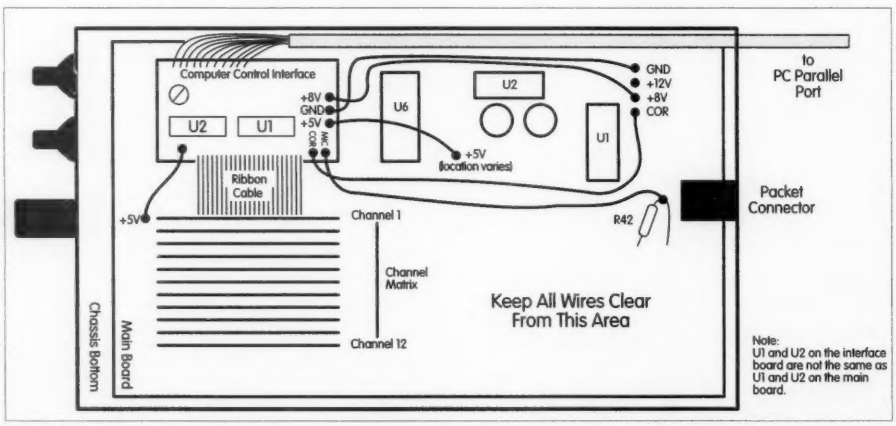

Fig. 1. The Computer Control Interface mounted above the Ramsey transceiver's address chips.

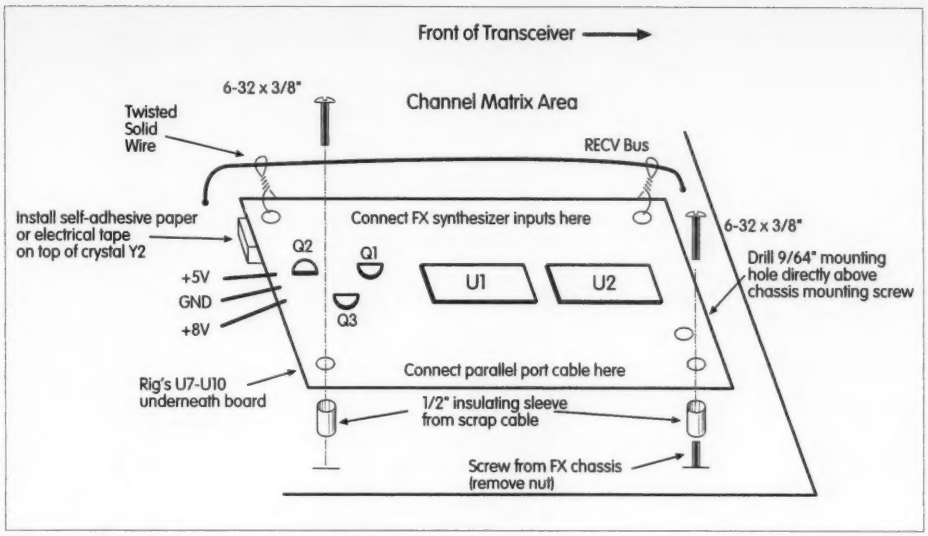

Fig. 2. *Mounting details, view from the left side.*

latches while Qs and Q's are serial outputs used for connecting several 4094s in tandem. The inputs are: data, strobe, clock, and output enable (OE).

A "latch" stores a voltage (low or high) and makes it available to the outside world from the chip. In our case here, the data is available for input to the rig's synthesizer chip. The term "low" means low voltage, or logic 0.

A "high" means high voltage (about 5 volts), or a logic 1. The term "rising edge" means a voltage transitioning from a low to a high (0 to 5 volts) and "falling edge" means the opposite.

When the clock input swings from a logic low to a logic high, data is shifted inside the chip's buffers. In other words, the data in the buffer for Q7 is moved to the buffer for Q8, then the data in Q6 is moved to Q7, and so on until Q1 is moved to Q2. The data that appears on the input data pin is moved to Q1. As long as the strobe input is low, the shifted data will not transfer to the output latch.

When the strobe input swings from high to low, the newly shifted data is latched to the output pins Q1 through Q8. Thus, after shifting new data, you only need to swing the strobe input from low to high and then back from high to low. If the strobe was already high and stayed there, when you shift data the outputs will reflect the data flow. For the sake of our circuit, we don't want to change the synthesizer inputs in a seemingly random fashion as we shift in the data of a new frequency, especially during scanning, so we must keep the strobe input low.

The output enable (OE) input determines the output state of Q1 through Q8. If OE is high, then the outputs contain logic lows and highs, depending on how you program the chip. However, if OE is low, then the outputs are "floating," or in a high impedance state. This is useful when you want to use the frequency selector switch on the transceiver and not let the chips interfere with other frequencies you select in the rig's channel matrix.

So, if you want to shift an eight-bit number into the chip's outputs (Q1 through Q8), do the following:

1. Keep the strobe input low and the output enable (OE) high.

2. Send a data bit into the data input.

3. Send a high to the clock input. The rising edge of the clock input causes the chip to shift all the data bits in the chip to shift one bit. The new data on the data input bit goes into D1 while the data in D7 goes into both Q8 and Qs. Having done this, send a low to the clock input. The negative edge of this transition causes the data on Qs to show up on Q's. Note that none of the bit transitions will actually appear on the D1 through D8 output latches as long as the strobe input is low.

4. Repeat steps 2 and 3 until all eight bits from a byte have been shifted into the chip.

5. Now, send a high and then a low to the strobe input. The falling edge of the strobe input copies the new data in the chip's buffers to the output latches Q1 through Q8. The new data will stay on the latch outputs no matter what is going on in the inputs, as long as the strobe remains low and OE remains high.

How the interface works in your Ramsey radio

The output enable (OE) input lends itself well to this project. It is hard-wired to the +5 connector from channel 1. If channel 1 is not selected (OE is low), outputs Q1 through Q8 will "float" and assume whatever state (high or low) as a function of another circuit.

The "other circuit" in our case is whatever frequency you select using the transceiver's frequency selector knob. Thus, when you select channels 2 through 12, you take away the +5 volts from OE and resistor R5 pulls the voltage down and causes the OE input to go low and the outputs to float. When you select channel 1, OE goes high and you will return to the frequency already stored in the interface and return to "computer control" mode.

OE shows up in bit 4 of the input port so your software can detect whether the interface is selected or not.

The interface has U1 and U2 in parallel with each other, not one in tandem behind the other. This allows only eight-bit shifts for both chips, rather than 16-bit shifts, which take longer to do. As you can see in the schematic, the interface does not use the Qs and Q's outputs.

U1 programs the upper eight-bit inputs (32k through 256) to the MC145152 synthesizer (the rig's U6 chip) while U2 programs the lower eight-bit inputs (128 through 1). Please note that the interface's U1 and U2 should not be confused with the transceiver's U1 and U2.

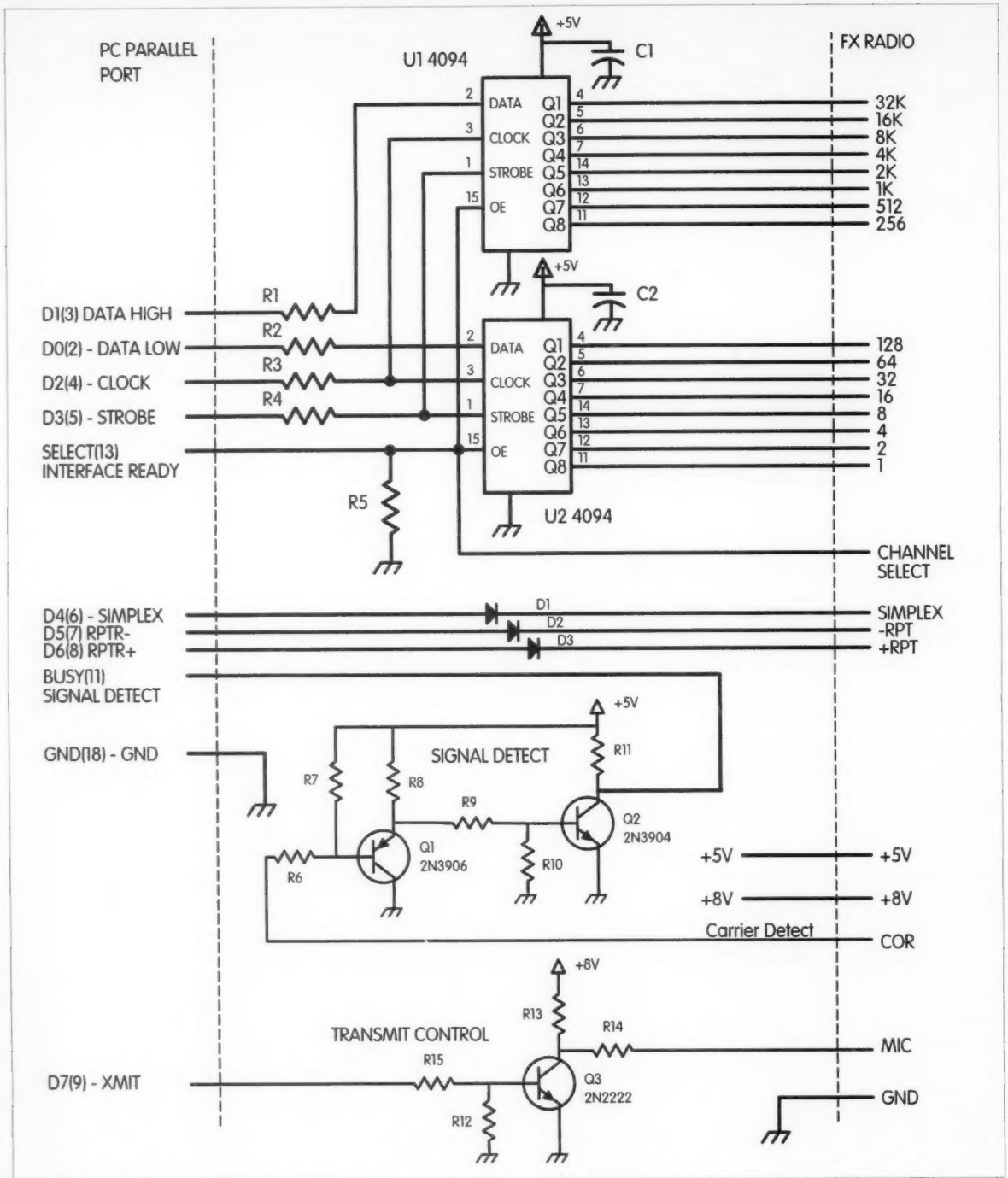

Fig. 3. *Ramsey FX radio/PC interface.*

The schematic shows the lower four bits of the PC's output parallel port being used for programming the inputs to the synthesizer. Bit D0 is connected to the data input of U2 while bit D1 is connected to the data input of U1. Your program will have to split the upper and lower halves of the synthesizer programming word (which is fully described in your Ramsey manual) and shift the bits (lowest bits first, or right shift) into the chips. Bit D2 controls the clock input and bit D3 controls the strobe input to both chips.

Bits D4 through D6 control the transmit offset selection on the transceiver. The programming of these bits must be consistent, and only one bit (D4, D5, or D6) can be high at a time. The Ramsey manual thoroughly explains how the transmit offsets work through the rig's adder chips (U6 through U10).

R1 through R4 limits current flow between the chip inputs and the PC

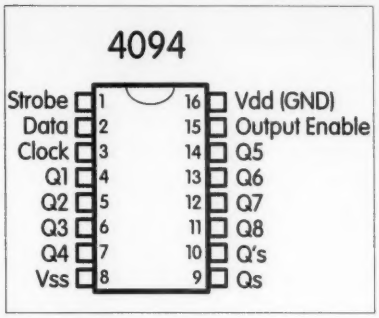

Fig. 4. Pin layout.

parallel ports whenever the PC is on and the radio (and interface) is off.

D1 through D3 protect the transceiver's 5-volt regulator when you have the transceiver on and the PC off.

Without these diodes, there may be a virtual short circuit condition when the PC is off which may cause the transceiver's 5-volt regulator to overheat and enter thermal shutdown.

The signal detect circuit allows your program to detect the presence of a signal. You can use this circuit to stop a scanning function if you sense a signal, and then resume scanning when the signal drops. The signal detect gets its signal from the COR output of the FX-146's product detector (U1). Since the COR is analog in nature, Q1 and Q2 convert the analog to digital and return a high for no signal and a low for a signal.

The COR output from your rig is part of the rig's squelch circuit. If you turn down the squelch until you hear background noise, the COR voltage will change and your PC will sense a "signal." In order for the signal detect circuit to work properly, adjust the squelch so that the background noise just drops off and leave it there.

The transmit control circuit uses the D7 output bit from the parallel port to control the transmit function.

This bit must always be low (for receive mode) when programming the frequency of the transceiver. Make sure you don't inadvertently set the transceiver in transmit mode by throwing random data on the output. In this circuit, R13 serves a dual function. First, it limits the collector current when you send a logic high to saturate Q3 and therefore lower the voltage going into the MIC input, which causes the transceiver to go into transmit mode.

Second, it keeps the MIC input high (keeps the rig in receive mode) if your PC happens to be off or in reset mode (booting up, when the output of the parallel port is in a high-impedance state). Connect the transmit control "MIC input" to the top of the rig's R42 (scrape away any insulating material first before connecting and soldering).

If, after assembling the interface circuit, the XMIT does not make your transceiver go into transmit mode, try reducing R14 to 68k or 47k. I had to do this for my FX-440 rig (100k was OK for the other three rigs).

Use the 5- and 8-volt supply directly from the transceiver. Both power supplies have ample reserves to power this interface.

Structure of the parallel port data register:		
Port address: First parallel port (LPT1) = 378H Second parallel port (LPT2) = 278H		
	Function	Male DSUB
D0	Data low	Pin 2
D1	Data high	Pin 3
D2	Clock	Pin 4
D3	Strobe	Pin 5
D4	Simplex	Pin 6
D5	-RPT offset	Pin 7
D6	+RPT offset	Pin 8
D7	XMIT	Pin 9
Structure of the parallel port status register:		
Port address: First parallel port (LPT1) = 379H Second parallel port (LPT2) = 279H		
	Function	Male DSUB
D4	Select (1 = rig is on)	Pin 13
D7	Busy (0 = signal detect)	Pin 11
	Signal Ground	Pin 18

Table 1. Structure of the parallel ports.

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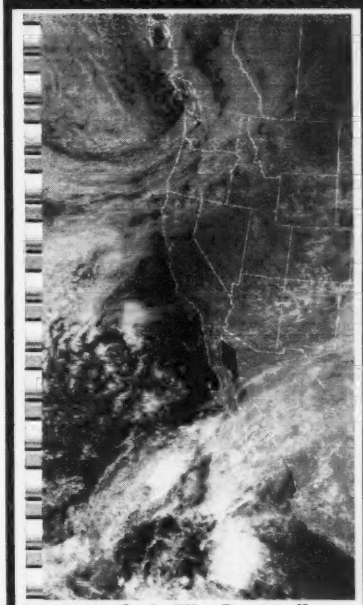

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A BASIC program showing how to program your radio can be downloaded from my FTP site. The ex-ample program requires Microsoft QBasic (available in DOS version 5 and above) or Microsoft QuickBasic version 4.5.

Additional programs are available from my FTP site. One is a deluxe, full-featured interactive scanner program, which you can run directly from the DOS command line.

How to find frequency limits

As with all radios, there are frequency limits. Ramsey doesn't tell you what the limits are, mainly because the limits can be changed somewhat.

They did tell you that your transceiver can be tuned to any 20 MHz segment, or 5 MHz segment for the FX-50. The transmitter range is much narrower, and it is just as well, so keep them tuned within the ham bands.

The transceiver's MC145152 frequency synthesizer has a Lock Detect output pin which, after being filtered, connects to the rig's U5, pin 5. You can connect a high impedance digital voltmeter to this pin.

When you tune to a frequency and it is within range, pin 5 will show about 5 volts, or at least more than 4 volts. If the voltage is lower than 3 volts, then you are out of range.

Remember, when building your kit, you had to tune your radio by adjusting coil L7 until you achieved a certain voltage at TP1 for a particular frequency? There is nothing sacred about the voltage value—it was Ramsey's way of ensuring that your radio would be tuned within a certain desirable frequency range, which would cover the entire ham band the rig was designed for.

You can tune L7 to move the frequency limits up or down. If you move the lower limit, you also move the upper limit. Just keep in mind that there is only so far you can go because of the limits of the coil and the overall circuitry (see **Table 2**).

Radio	Low Frequency	High Frequency
FX-50	48.650	54.550
FX-146	137.370	171.100
FX-223	204.270	265.900
FX-440	400.150	471.000

Table 2. *Receiver frequency range for various radio models.*

As you can see, the UHF radios have a higher frequency range than do the VHF radios. However, the transmitter still has a narrow range (by default, that helps to keep your transmissions within legal limits).

Availability

You can get all the software I have for programming your rig(s) using the circuit described in this article. The programs run in DOS mode. You'll find several programs in my FTP site; if you prefer, you can write your own software and use the frequency programming routines as a guide or an addition to your programs.

Send a blank diskette (5-1/4 or 3-1/2) plus five dollars (to cover S&H) and I will return it to you loaded with all the software I have. If you can access the Internet, check out my humble FTP site at [ftp://members.aol.com/rlucka/fxradio].

Please note one important point: Even though the Ramsey transceivers are capable of transmissions outside the ham bands, you must have an appropriate license to transmit outside the ham bands, just as you must be licensed to transmit within the ham bands. In addition, even if you are licensed to operate in a business segment that the Ramsey can tune to, the Ramsey is not type-accepted for use in these bands. Any excursions outside the ham bands must be "receive-only."

The FCC expects you to maintain strict control over your new capabilities and will enforce strict penalties for unlicensed transmissions, whether malicious or accidental.

If you have any ideas, suggestions, questions, whatever, feel free to contact me with an SASE or E-mail me at [rlucka@aol.com]. I plan to add to or improve the software and leave the latest versions in my FTP site, so check in once in a while to see what's improved or new. Some of the additions and improvements may be from your ideas, so communicate!

The transceivers are available in kit form from:

Ramsey Electronics, Inc.
793 Canning Pkwy
Victor NY 14564
(716) 924-4560

FX-Series Interface Parts List	
C1, C2	0.1 µF
D1, D2, D3	1N4148
Q1	2N3906
Q2	2N3904
Q3	2N2222
R1, R2, R3, R4	1k
R5, R6, R9, R11, R12, R13	10k
R7, R14	100k
R8	4.7k
R10	3k
R15	47k
U1, U2	MC4094 or MC14094
Circuit Board	RS 276-150
12-wire cable for connection to PC parallel port	
Ribbon cable (optional)	
Male DSUB connector for PC parallel port	
Chip socket for U1, U2 (optional 16-pin sockets)	
Small-gauge wire for point-to-point connection (solid preferred)	
Mounting hardware (see text): machine screws, cable insulators, insulating paper, bell wire	

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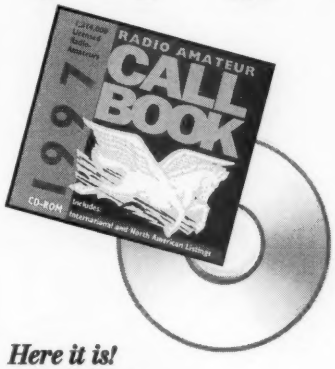

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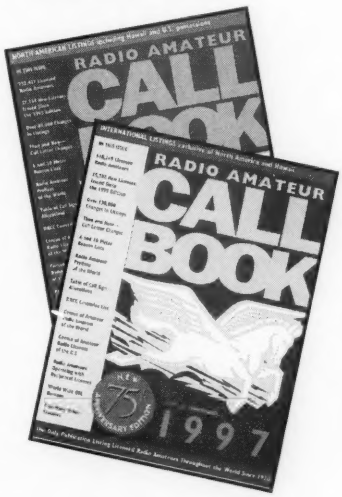

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TV/VCR Tuner Applications (Part 3)

Hugh Wells W6WTU
1411 18th Street
Manhattan Beach CA 90266-4025

Spectrum analyzer

Perhaps one of the handiest tools for electronics is the spectrum analyzer. In essence, it is a receiver having an oscilloscope attached which is used to provide a spectral view of a band of selected frequencies. The amount of spectrum to be viewed can be varied for either a close-up view of the signal, or a greater amount for viewing all of the adjacent signals within the band. The usefulness of the spectrum analyzer is great, with many applications. To name a few: transmitter sideband analysis, spur generation analysis, frequency spotting and identification, identifying modulation mode, harmonic signal analysis, and use as a wide frequency range receiver.

The spectrum analyzer described here is constructed using relatively easy to obtain components so that it is a project within reach of any ham experimenter. The two main components are the TV/VCR tuner and a receiver. Although a receiver board may be constructed, almost any receiver capable of tuning to the tuner's IF (46–63 MHz) and having an AM detector will create a fine spectrum analyzer. I assume that you prefer to use a pre-built or commercial receiver, so a simple home-brew receiver will not be discussed. Many suitable receivers are available that will tune the 46–63 MHz region, such as six-meter AM and 30–50 MHz WWII military receivers. Even a 27-MHz CB AM radio used in conjunction with a 47- to 27-MHz converter will work well. The narrow IF bandwidth of the receiver provides narrow dispersion for viewing signal carrier and sideband characteristics.

The block diagram in Fig. 1 shows the major components and interconnects for a spectrum analyzer. When in operation, a sawtooth voltage is applied to the tuning voltage line, causing the tuner to sweep across a band of frequencies. Any received signal within that band will be translated to a DC voltage whose amplitude is relative to the strength of the signal which is then displayed on the vertical plane of the oscilloscope. In order to maintain a steady display on the screen, the horizontal scope sweep must be synchronized with the sawtooth generator. The sweep speed is set just high enough to eliminate viewing flicker. A high sweep speed does nothing to improve the display. Any basic oscilloscope may be used, but perhaps the main requirement for the scope is to have a DC input so that it will respond to the rectified output signal from the receiver's AM detector.

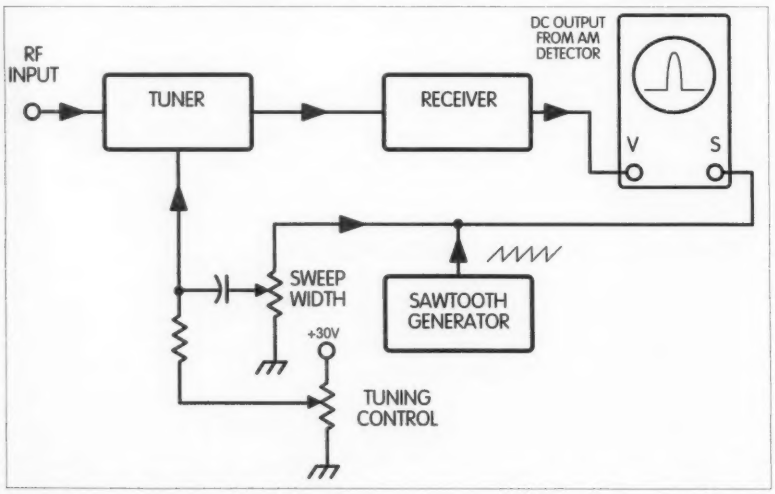

Fig. 1. Spectrum analyzer block diagram.

Fig. 2 shows the complete schematic for the spectrum analyzer with the exception of the receiver details. To drive the tuner sweep circuit, a unijunction transistor was chosen to generate the sawtooth waveform, but any sawtooth generator circuit will work in this application. In order to provide a fairly linear sawtooth ramp, a JFET is used as a constant current source for charging the timing capacitor. A voltage pulse is taken from the B2 terminal of the UJT to provide a sync pulse for the scope.

As an alternative sweep source, some oscilloscopes provide a horizontal sweep sawtooth output which may be divided down with resistors and applied to the sweep width pot. The sweep voltage amplitude as generated within the scope may be as high as 100 volts, but the maximum desired sweep voltage is about 10 volts when applied to the sweep width pot. On the average only 0.5 to 1 volt is required to provide a normal spectral display (sweep width).

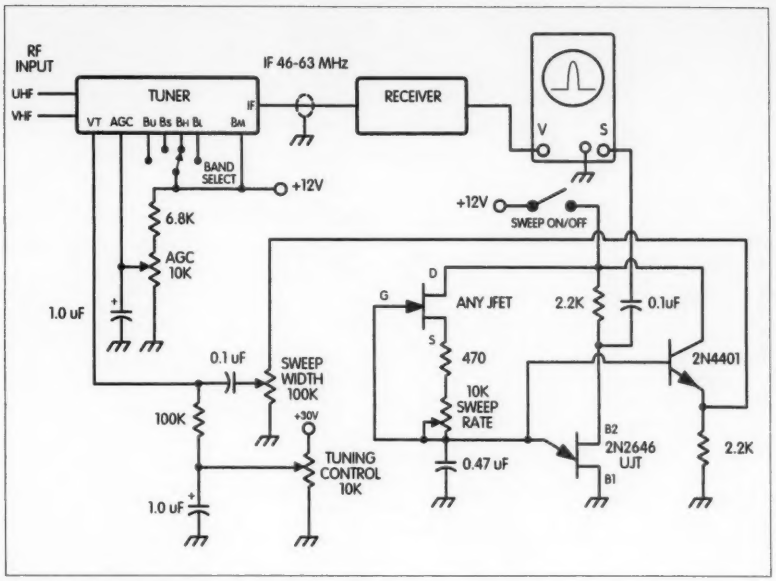

Fig. 2. Spectrum analyzer schematic.

Power supply regulation, although not as critical for the +12 volt line, is recommended to reduce tuner drift. Regulation is very critical for the tuning voltage circuit, however, and care must be taken to remove all ripple and noise. The tuning is performed by using a 10k pot across the +30 volt source. For vernier tuning control, a 10-turn pot and a counter knob are recommended.

Almost any small 24–28 volt, 100-200 mA, power transformer is suitable for use in the spectrum analyzer. It is suggested that filter capacitors have a value equal to or greater than 3300 µF to keep power supply ripple and noise to a minimum.

Mechanically, the circuit is very stable and can be mounted in any convenient manner to suit your taste.

Signal source

TV/VCR tuners were designed to be the front end of a receiver. As such, they contain a local oscillator which is used to mix with the incoming signal to create an IF of approximately 47 MHz. The tuner, as a receiver front end, covers a received frequency range of 45 to 900 MHz. The oscillator operates above the received frequency and is offset by the IF (46-63 MHz). Therefore, the oscillator operates over the range of approximately 90 to 950 MHz. The actual oscillator range is dependent upon the specific tuner. Typically, TV oscillators tune from 91 to 940 MHz while VCR oscillators tune from 108 to 955 MHz.

Some tuners are set up with a phono connector near the oscillator circuit that outputs the oscillator signal to the PLL frequency control circuit. In most cases, the output is frequency-divided prior to exiting the tuner case, making the output generally unusable. However, some tuners provide a direct oscillator output, and when that is the case, the tuner will work as a signal generator without modification. When

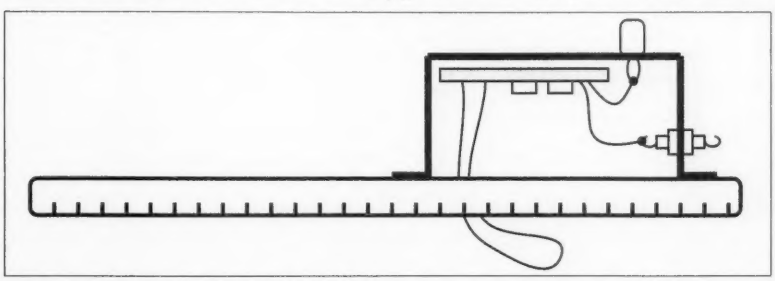

Fig. 3. Amplifier mounting and coupling. The pickup loop feeds signal from the oscillator to the amplifier board.

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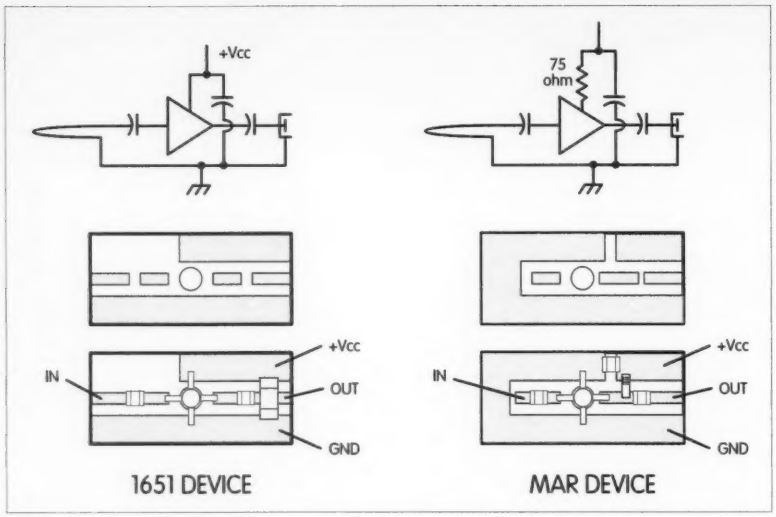

Fig. 4. *Schematic, PC board layout, and parts placement for the amplifier board, shown for the two devices discussed in the article.*

access to the oscillator is not available, the tuner may be modified slightly to obtain a direct signal from the oscillator. There are many techniques available to capture the oscillator signal, but only one technique will be described here.

The concept for capturing the oscillator signal is shown in Fig. 3 and involves drilling a hole in the tuner cover to provide access for a wire pickup loop to pass through the hole, allowing the loop to lie close to the oscillator circuit. The loop picks up a signal which is fed into a broadband amplifier. A coupling capacitor is connected between the loop and the amplifier to satisfy the isolated DC input requirement of the amplifier. The amplifier provides a constant load on the oscillator and is used to amplify the signal captured by the loop. If the tuner cavity is large enough, the amplifier may be mounted inside of the tuner rather than on the cover. Otherwise, the amplifier must be mounted outside of the tuner. To prevent radiation from the amplifier, the circuit must be enclosed in a metal box made from a tin can. The box is made RF-tight and soldered to the tuner cover. The box may be of any convenient dimensions, but it must be RF-tight.

Power for the amplifier is in the range of 4.5 to 5 volts. To prevent chip heating, the voltage at the chip should not exceed 5.5 volts. The power to the amplifier must be fed via a high capacity feedthrough.

A phono connector may be mounted on the amplifier box and used as an RF output connector. The amplifier output impedance is 50 ohms. To provide proper amplifier operation, the chip is mounted on a small piece of printed circuit board which is glued to the inside of the box.

The amplifier chip used in the original design of the circuit was an NEC UPC1651G. As an alternate part, a Mini-Circuits MAR-1 or MAR-2 may be used. A 75 ohm 1/4 watt resistor is used with the MAR series chip to source Vcc to the chip. An output impedance of approximately 40 ohms is achieved, which will source a 50 ohm line satisfactorily. The respective chip circuits are shown in **Fig. 4**. Capacitor values used in the circuit are not critical, as any value from about 0.001 to 0.5 uF will work. It is important to keep the physical size of the capacitor small and lead lengths kept very short. Chip capacitors are preferred when available.

After making the tuner into a signal generator, it will still function as a normal signal converter/tuner. The addition of a pickup loop will shift the oscillator frequency a small amount, but not enough to prevent the tuner from functioning as designed.

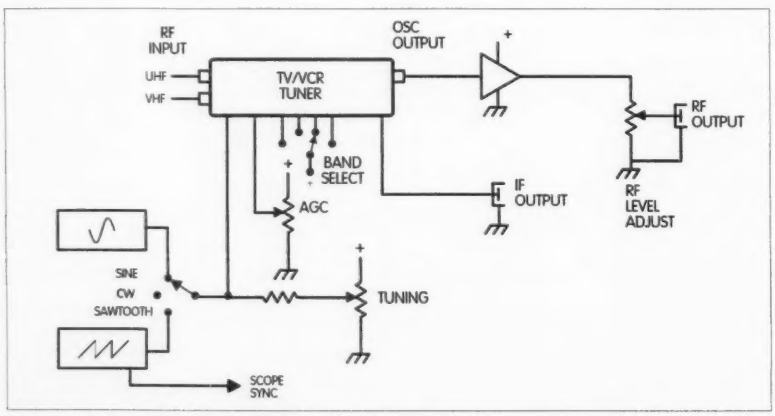

Fig. 5. *Multifunction signal device block diagram.*

Multifunction signal device

If you haven't noticed, all of the new pieces of ham equipment abound with a multitude of functions and capability. As a result, some marvelous equipment and innovations are offered to the ham community. Equipment designed and built by hams may also exhibit multiple innovations when a little thought is applied.

Parts/components for ham-designed equipment come from some surprising sources and places. Therefore, it should come as no surprise to find TV/VCR tuners designed into a multifunction device having the following functions: frequency converter, spectrum analyzer, signal generator, sweep generator, and standard deviation signal source. All of the indicated capability is achieved with external circuits and with a minor modification to the tuner to extract a signal from the local oscillator.

Before we conclude, let me remind you that the actual frequency band obtained from a tuner is determined by the individual manufacturer's design. Therefore, all frequencies indicated

here can only be used for reference. Refer to the previous articles in this series for more information.

Tuners typically require two source voltages for proper operation. Positive 12 volts is applied to the mixer/oscillator and band control circuits, and is divided with a pot for the AGC. The AGC may be used as the RF gain control. A variable voltage from 0 to 30 volts is used for tuning. Both of the voltage sources should be regulated to achieve best tuner stability. It is also recommended that large value filter capacitors be used to keep power supply ripple and noise to a minimum.

For a TV/VCR tuner to be useful as a signal generator, a signal output must be obtained from the local oscillator. Some tuners have a phono connector mounted next to the oscillator circuit which was used to output a signal to the PLL. Some tuners have the oscillator output divided before it exits the tuner which reduces the tuner's desirability. However, modifying the tuner will allow obtaining a direct signal from the oscillator.

"A wealth of testing for very little cost..."

Fig. 5 shows a block diagram of the multifunction signal device with a tuner as the major component. Output from the oscillator is sampled and amplified using a monolithic RF amplifier chip. A pot in the amplifier's output circuit is used to control the signal output amplitude. As a signal generator, three modulation functions are provided. Obviously, when in the CW mode there is no modulation present, but modulation is present when either a sine wave or sawtooth waveform is used. FM is the resulting modulation mode when either waveform is applied.

Fig. 6 shows the schematic for the multifunction signal device. To build the device, it is recommended that the supporting articles be reviewed to gain additional technical information.

Following is a brief description of each function of the device:

Frequency converter. The TV/VCR tuner was designed to be the front end of a receiver so no tuner modification is required to use it for that purpose.

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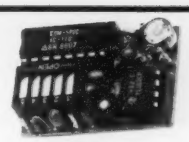

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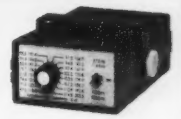

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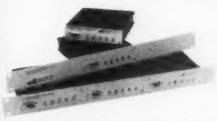

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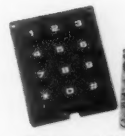

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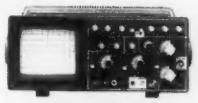

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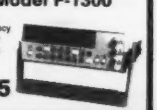

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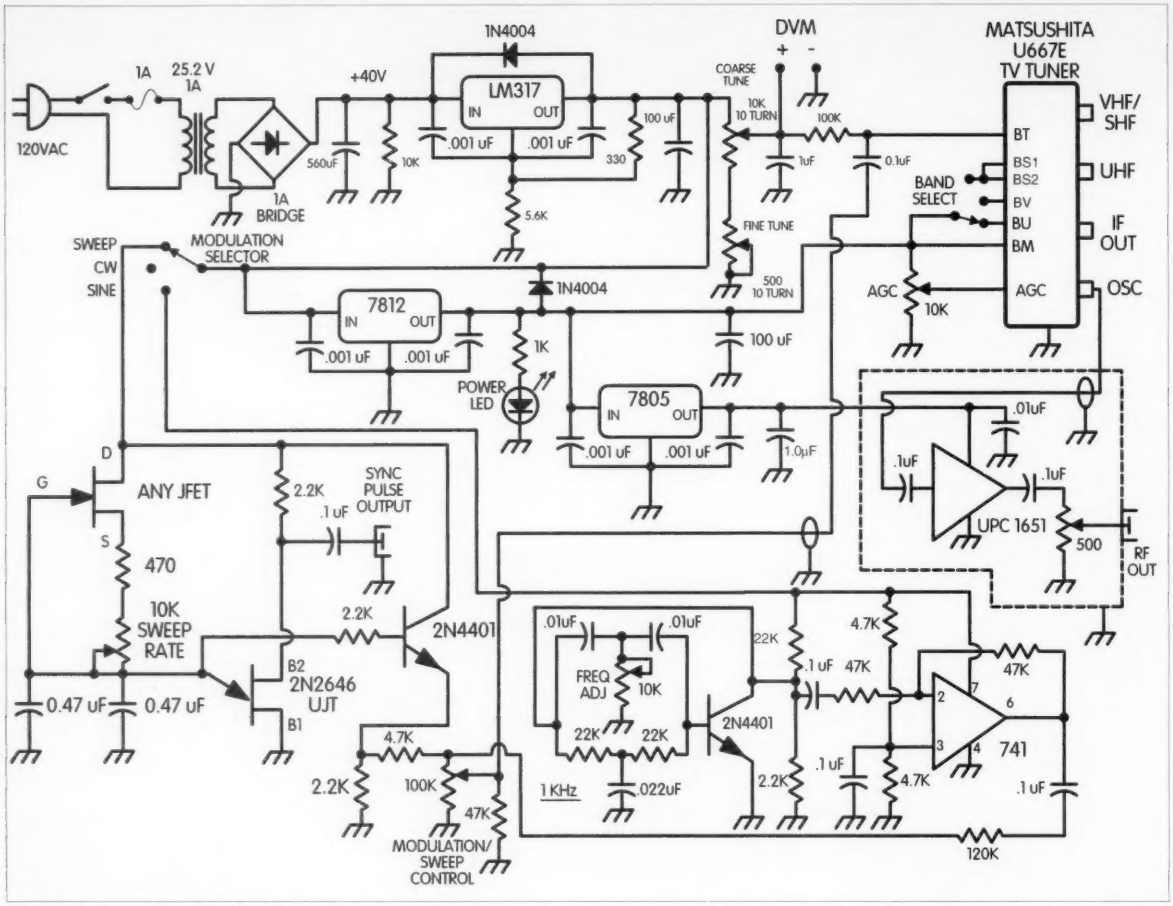

Fig. 6. *Multifunction signal device schematic.*

Any receiver capable of tuning to the tuner's IF will work well. To name a few: 6-meter receivers, scanners, WWII 50-MHz receivers, and a CB radio used with a 47–27 MHz frequency converter. As a downside, it must be mentioned that tuner drift may be noticed when a narrow passband receiver is used with the tuner. Using the tuner outside of a PLL, the local oscillator frequency stability is subject to voltage and thermal variations.

Spectrum analyzer. The multifunction signal device becomes a spectrum analyzer when used as a frequency converter. An AM receiver with a DC output voltage obtained from the detector is used to provide a signal to the DC input of an oscilloscope. A voltage pulse from the sweep generator is used to synchronize the scope sweep with the tuner's spectrum sweep.

Sweep signal generator. When a sawtooth signal is applied to the generator, the frequency of the generator will sweep across a band of frequencies and then snap back to the starting frequency. The frequency sweeping process is repetitive and the sweep range is controlled by the amplitude of the sweep voltage.

There are two major objectives when using a sweep generator. The first is to profile the frequency response of a resonant circuit, RF or IF amplifier, or any other narrow passband circuit. The second objective is to provide the necessary sweep voltage for sweeping the tuner over a band of frequencies when the tuner is used as the front end of a spectrum analyzer.

Standard deviated signal source. The objective of modulating the signal generator with a sine wave has two advantages. The first is to provide audio modulation for identifying the output signal when the device is used as a signal generator. The second objective is to generate a signal having a specific value of deviation. In the process of deviating a signal, sideband energy is created as a function of the frequency of modulation and the rate of deviation. As the amount of deviation is increased from zero, the carrier will pass through a series of null points which are used as a measure of deviation.

A 1-kHz sine wave provides a predictable carrier null vs. deviation at 2.405 kHz at the first null and 5.520 kHz at the second. The carrier null can be observed using a receiver having a BFO centered on the generator's carrier, which will null at a specific deviation as the amplitude of the modulation is increased from zero to that point.

It should be noted that the multifunction signal device can be built and tested a section at a time, or you can build just as much as you need. Whether you build just the spectrum analyzer or the complete multifunction unit, the use of a surplus TV tuner provides a wealth of test capability for very little cost. 73

The NiCd Health Maintenance System

Build this project to get maximum life out of your expensive NiCd batteries.

Sam Ulbing N4UAU
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Radio control projects, hand-held radios and GPS receivers are just a few of the many places we use expensive NiCd batteries. To get maximum life out of these batteries it is necessary to properly maintain them. Overcharging and overdischarging them can shorten their life significantly. Short-cycling them a lot will also reduce their capacity because the metal crystals in the battery will coalesce if left undisturbed for a long time, increasing the internal resistance and lowering the terminal voltage. Repeatedly charging the batteries after only partial discharge will leave the lowest layers of the metal undisturbed, allowing them to coalesce. This effect can be eliminated by completely discharging the cell occasionally before it is charged. The NiCd Health Maintenance System consists of three easy-to-build projects that will help you to get the most out of these expensive batteries.

• The NiCd Health and Fitness Center (**Photo A**) will let you pre-condition and recharge your battery packs correctly. It will prevent overcharging and reduce "memory" effects due to short cycling.

• The NiCd Personal Fitness Advisor will help you identify weak or aging cells within a battery pack, so you can match like cells for maximum life or discard worn-out cells.

• The NiCd Tiny Fitness Tester (**Photo B**) is a portable, self-powered, very small unit that will let you accurately measure your battery voltage when you are away from your Fitness Center. It is much smaller than a standard digital voltmeter, so it's easy to take it with you when you travel.

This project was inspired by an "Idea for Design" by John Wettroth in *Electronic Design Magazine*, January 22, 1996. I felt I could improve the design with some modifications and additions. Though the project I describe is designed for use with four cells, it is possible to modify it for a different number of cells.

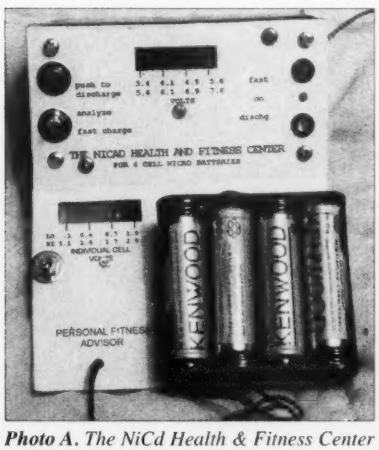

***Photo A.** The NiCd Health & Fitness Center with the Personal Fitness Advisor.*

The NiCd Health & Fitness Center (H&FC)

The H&FC will keep your batteries in good shape by exercising them properly. Put your batteries in it at night and by morning you will have healthy reconditioned batteries ready to go. It consists of:

• An auto discharge circuit that will discharge your batteries to the proper voltage to reduce crystal coalescence, and then automatically initiate the recharge process.

• A MAX713 fast charger chip (U2), which charges the batteries quickly without overcharging them.

• An LM3914 voltmeter (U1), which accurately displays your batteries' voltage so you can decide when to charge or discharge.

Using the H&FC

Insert your batteries, set switch (SW1) to "analyze" and turn on the power. The built-in voltmeter will show the battery voltage from 3.4 volts (.85 per cell) to 5.60 volts (1.4 per cell) in 10 steps. You can remove and use them, or you can decide to recondition them by either just charging them or discharging and then automatically recharging them.

To charge your batteries move SW1 to "Fast Charge" and the charging IC will begin to charge the batteries at 250 mA, which is about one third of the capacity of AA NiCds (called a C/3 charge rate). When the charge cycle is done (three to four hours) the H&FC will switch to a trickle charge mode (C/16). Notice that this trickle rate is much less than the C/10 rate commonly used by "slow" chargers, greatly reducing chances of overcharging if the batteries are left connected to the charger for a long period of time. The H&FC displays the battery voltage during charging to give you a feel for progress.

***Photo B.** The Tiny Fitness Tester, compared to a standard DMM.*

You can also choose to discharge your batteries to recondition them (the complete workout). Push the discharge button and the circuit connects the built-in discharge load. Again the voltmeter monitors and displays the battery voltage. When discharge is complete (voltage is less than .85 volts per cell), the discharge cycle is terminated and the charge cycle begins automatically.

Circuit description

See **Fig. 1**. U1 is a 10-step voltmeter based on an LM3914. If the battery being measured at pin 5 has a voltage less than the minimum level set, no LEDs will be on. As the voltage increases, LEDs will start to turn on one at a time, from left to right, until the voltage reaches or exceeds the maximum level set. Which LED is on gives an accurate indication of battery voltage.

The maximum and minimum levels of this voltmeter are set by R1, R2, and R3. A current (I) from pin 7 of U1 which is set by R3 flows through R1 and R2 to ground. The voltage across R1 (V=I*R1) is measured at pin 4 and sets the minimum voltage level (Vlo). The voltage across R2 (V=I*R2) plus Vlo set the maximum voltage level (Vhi) which is measured at pin 6. The current (I) is set by an internal voltage reference and the variable resistor R3. By properly choosing R1, R2 and R3, any voltage range can be set. I selected my resistors to turn the first LED on when the battery voltage exceeded 3.4 volts. This is 0.85 volts per cell which is the "fully discharged" value recommended for NiCds. I set the maximum level, when all LEDs are on, at 5.6 volts. This is 1.4 volts per cell, and is near the highest voltage a NiCd will normally be.

The LM3914 may seem like a simple voltmeter compared to the 3-1/2 digit LCD meters commonly used, but it is really quite accurate and it has much more versatility, making it ideal for a project such as this. The accuracy of the voltmeter is found by looking at the voltage range and number of steps: (5.6-3.4)/10=.22 volts per step, roughly ±2% of the 5 volt battery it is measuring. To achieve this accuracy, it is necessary to have the values of

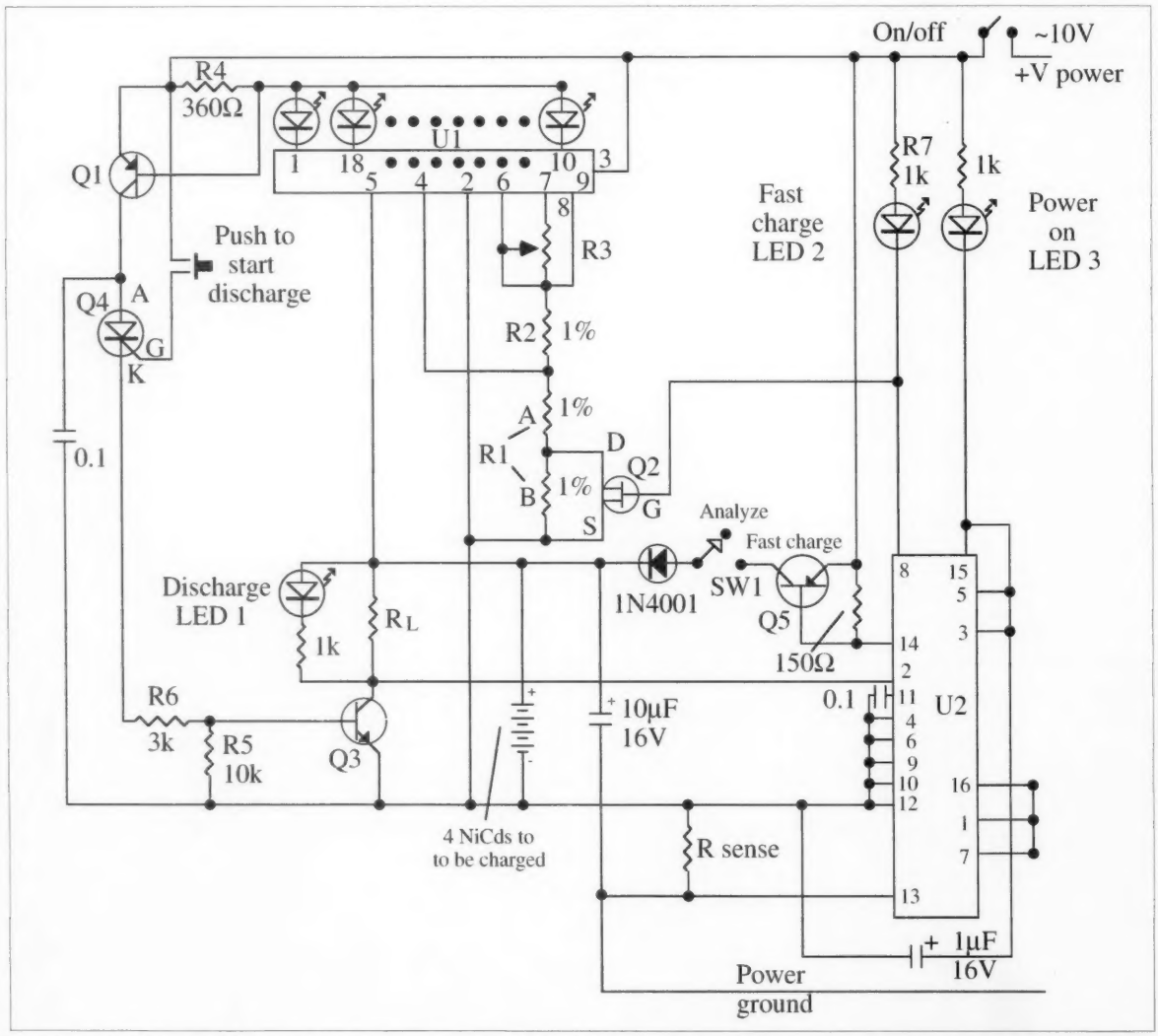

Fig. 1. The NiCd Health & Fitness Center schematic. Q1 = PN2907. Q2 = ZVNL110A MOSFET. Q3 = PN2222. Q4 = SCR EC103B. Q5 = TIP32 with heat sink. R1A = 2.94k 1%. R1B = 1.82k 1%. R2 = 2.94k 1%. R3 = 2k multiturn. Rsense = 1Ω 1W. RL = 33Ω 1W. All resistors 5% unless noted. U1 = LM3914. U2 = MAX713.

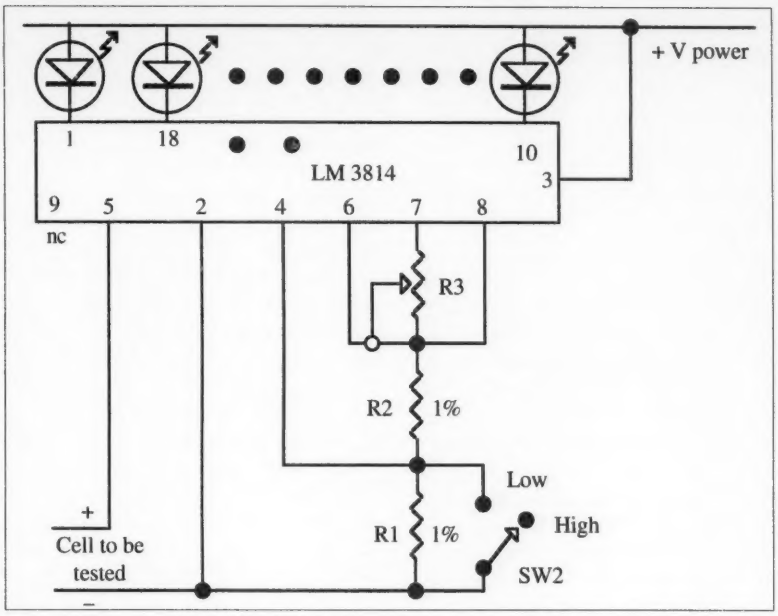

Fig. 2. *The Personal Fitness Advisor schematic. R1 = 1.78k 1%. R2 = 2.15k 1%. R3 = 5k multiturn pot.*

R1 and R2 be at least as accurate. I used 1% resistors for these resistors. The versatility of the LM3914 will become apparent when we look at the operation of the circuit in more detail.

U2 is a NiCd fast charger IC made by MAXIM. It is designed to permit rapid charging of NiCds without overcharging them. U2 runs in either a fast charge mode or the trickle charge mode. When it is connected to a battery it senses the voltage at pin 2 and, if it is greater than 1.4 volts (.35 volts per cell), U2 will enter the fast charge mode. This lower limit of 1.4 volts prevents U2 from putting a large amount of current into a possibly defective battery pack. The fast charge current (I) is set by Rsense (I = .25/Rsense). I selected a 250 milliamp charge rate which will fully charge AA batteries in three to four hours. When U2 determines that the batteries are charged, it will switch to a trickle charge so as not to overcharge them. The trickle rate is about 40 mA. U2 determines when the batteries are charged by using a method called voltage slope detection. When a NiCd is fully charged, the voltage will stop rising and actually drop a small amount before it again starts to increase due to overcharging. U2 will detect a voltage drop of as little as 2.5 millivolts and use it to terminate the fast charge. As a safety precaution, U2 will also keep track of the charging time and if a negative voltage slope is not detected within a set period of time (four and a half hours for our circuit) it will realize that there is a problem (the battery should have been fully charged in less than 4 hours) and will terminate the fast charge to prevent further damage to the batteries.

The rest of the circuit is best understood by looking at what happens when a discharge cycle is started with the discharge button.

Choose V lo, V hi, I1; then calculate resistors:
R3 = 1.28/I1
R1 = V lo/(I1 + .075)
R2' = (V hi - V lo)/(I1 + .075) This is a temporary variable to make calculating R2 easier.
R2 = R2' * 10/(10 - R2')
I1 is in milliamps
R1, R2, R2', R3 are in k ohms
V hi, V lo are in volts

Table 1. *Equations to select resistors for a voltage range.*

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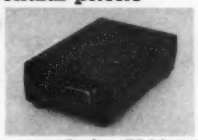

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Q4 is a silicon controlled rectifier (SCR) which is normally off. It is turned on when the discharge button is pushed and the gate (G) is pulled high. Once turned on, an SCR will let current flow from its anode (A) to its cathode (K) and it will continue to do so until this current goes to zero. It will then turn itself off, and stay off, until the push-button is pushed again. In our circuit, if the collector of Q1 is turned on and the SCR is on, current will be able to flow from Q1 through R5 and R6 to ground. This current will cause a positive voltage on the base of Q3, turning it on. Turning on Q3 creates a discharge path for the NiCds through RL. LED1 will also turn on, showing that discharge is occurring. In order to stop this discharge, it is necessary to turn off the SCR—here is where some of the versatility of U1 is seen.

As the battery discharges, the lower voltage will cause voltage-indicating LEDs to turn off one at a time from right to left. When the voltage drops below our minimum 3.4 volts all the LEDs will be turned off and discharge is stopped by Q1 which monitors the current to the LEDs of U1. As long as an LED is on, current will flow through R4, and Q1 will be turned on due to the emitter-to-base voltage drop across R4. As soon as all LEDs are off, the R4 current goes to zero and Q1 turns off. With Q1 shut off, the current flowing through the SCR stops and it shuts off. With no current flowing through R5, Q3 shuts off and the discharge cycle ends.

Pin 2 and pin 12 of U2, the MAX713, measure the voltage across Q3. During discharge Q3 is turned on, so the voltage across it is small. Recall that the internal circuit of U2 prevents it from going into a fast charge state if the voltage at pin 2 is less than 1.4 volts. U2 will be in a trickle charge mode passing about 40 milliamps. This current also flows through RL and must be accounted for in setting the value of RL. When the discharge cycle is done and Q3 turns off, pin 2 of U2 sees the no load voltage of the NiCds (3.4 volts in this case) and it initiates the fast-charge cycle. Battery voltage will rise rapidly for a while, and U1 will display this voltage change as LEDs start to turn on again. But even though the LEDs turn back on, Q3 will not start another discharge cycle, because the SCR has been turned off and it cannot turn on again until it is manually restarted by pushing the discharge button.

During the fast-charge cycle, the battery voltage will soon rise above 5.6 volts which is the upper range set for the voltmeter. To monitor this higher voltage it is necessary to shift the range of the voltmeter. This is done automatically by Q2 (a MOSFET). During trickle charge, the fast-charge indicator (pin 8) of U2 is in a high impedance state so the gate of Q2 is held high by the 1k pull-up resistor (R7) through LED2. This turns on Q2, which shunts part of R1 (R1B), giving a lower voltage at pin 4 and pin 6 of U1, since only R1A is in the voltage-setting circuit. During fast charge, pin 8 of U2 goes low to turn on the fast-charge LED indicator. This also shuts off Q2, and now R1B is added to the voltage level circuit of U1 and both Vlo and Vhi will be shifted higher by an amount equal to I*R1B. I set my higher range to be between 5.4 and 7.6 volts.

Charging current flows to the NiCd battery through pass transistor Q5. The control voltage at pin 14 of U2 adjusts the base current of Q5 to maintain a constant current flow to the battery. Q5 must be a transistor capable of handling at least the amount of current that the fast charge cycle is set for (250 milliamps in our case). More importantly in designing the circuit, it is necessary to determine the power loss in Q5. I initially powered my H&FC from a 12-volt power source. With a current of 250 mA to my four NiCd cells, the power dissipated in Q5 was (12-4)*.25 = 2 watts. I chose a TIP32 for Q5, which is capable of handling this power with a good heat sink, but I found even though I had a heat sink on the transistor, it got quite hot. I decided to use a 9-volt regulator to reduce the power dissipated in Q5 to (9-4)*.25= 1.25 watts. The regulator dissipates the rest of the heat (12-9)*.25=.75 watts. With heat sinks on both Q5 and the regulator, they both stay cool during operation.

The Health & Fitness Center is a useful project by itself but by building 2 more simple circuits using the LM3914 even more benefits can be realized.

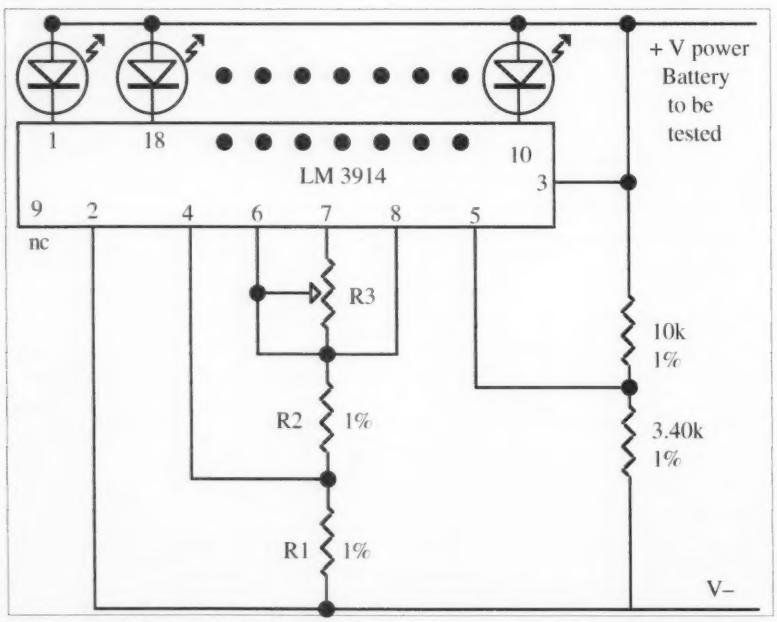

Fig. 3. *The Tiny Fitness Tester schematic. R1 = 2.00k 1%. R2 = 549 1%. R3 = 5k pot.*

The NiCd Personal Fitness Advisor (PFA)

Identifying weak cells within a battery pack requires a voltmeter capable of accurately measuring the voltage of individual cells. If a battery has a high internal resistance, it should be most obvious when the battery is under a load. I added a modified version of the LM3914 to my H&FC to let me check individual cell voltages during discharge and charge, to see if any are acting strangely.

Fig. 2 shows the circuit for my PFA. I wanted 100 mV accuracy, but also wanted to be able to test the voltage of a weak battery, both during discharge and fast charge. During discharge a weak battery is apt to be at a much lower voltage than the other cells, so I set the lower limit to 0 volts. During fast charge I wanted to be able to measure to 2 volts because a cell with a high internal resistance might get this high. Note that one of the safety features of

the MAX713 is that it limits its charging voltage to 2.0 volts per cell as a safety precaution. With healthy batteries no cell should be near this high value.

To be able to measure a range of 2 volts and still have the accuracy I wanted, I made the PFA a two-range voltmeter similar to the one in the H&FC. When the SW2 shorts R1 the lower range is 0 and the upper is 1 volt. When SW1 is open, R1 adds 1 volt to the lower range and the PFA measures from 1 to 2 volts.

Notice one other difference in this circuit. The LM3914 measures voltage relative to its ground. But in a multi-battery pack only one battery has its cathode at the system ground. To measure the other batteries, the ground lead of the LM3914 is actually at the potential of the battery cell below it. This causes a small additional current to flow through this cell, but I have set R3 in my PFA so that its total current is only about 10 mA. This current does not disturb the system and the PFA has no problem getting accurate readings of all cells. It is also why I used a manual switch for SW2 instead of connecting it to U2.

The NiCd Tiny Fitness Tester (TFT)

A third version of the LM3914 lets me accurately measure the batteries' voltage in the field when the H&FC is not available. It is the four-cell version of the Tiny Tic-Tac Tester I described in an earlier *73* project (*73*, March 1996). I built my tester in a breath mints box, which makes it very portable—it's small and needs no power source because it gets its power from the battery it is measuring. I carry mine in my shirt pocket and I can test my batteries anywhere quickly. With it I can avoid the embarrassment of having my batteries run down at a critical time.

Fig. 3 shows the TFT. Because the measured voltage must be at least 1.5 volts lower than the supply voltage, I use a voltage divider to halve the voltage to pin 5. One of the considerations in this version is to minimize power consumption from the battery being measured. This is done by selecting R3 to minimize the current out of pin 7. This current not only sets the voltmeter ranges as we discussed above, it also controls the current through the LEDs. LED current is controlled by the LM3914 to be 10 times the current out of pin 7 (that's why you don't need any resistors to protect the LEDs). For my tester I set R3 at 2.5k, which gives an LED current of 5 mA, and a total current draw of about 10 mA.

Building this project for a different number of cells

These three easy-to-build projects will help you get maximum life from your NiCds because you can:

- Measure your NiCd batteries' voltage accurately
- Fast charge them safely
- Discharge them correctly
- Look for weak cells
- Check them in the field

I have discussed only the four-cell circuit that I built, but it's easy to modify the design to accommodate many different battery configurations. **Table 1** shows the equations needed to modify the LM3914 for different voltage ranges. Note that for maximum accuracy, it is necessary to consider the resistance of the internal voltage divider of U2 and the additional current from pin 8 needed for the voltage reference (~75 microamps). *The ARRL Handbook* discusses programming the MAX713 for different conditions; it can be set to charge one to 16 cells, and for a programming time of 22 to 264 minutes. 73

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The "Cobra" Antenna

It's got a more powerful bite than the "Rattlesnake."

Raymond A. Cook W4JOH
606 Georgia Avenue
Valdosta GA 31602

Gene Rhodes W4FNY, my friend for more than fifty years, has striven all the time I've known him toward the ultimate antenna. For the past several years, he had used what he called his "Rattlesnake" antenna, which transmitted an excellent signal from De Leon Springs, Florida. Recently he moved to Orange City, about seventeen miles from his previous QTH. Inexplicably, his "Rattlesnake" did not perform as well as it had at De Leon Springs.

He said he thought the ground system there was better, so I suggested that he run a heavy-gauge ground wire back to his old QTH. After some reflection, that solution was deemed impractical.

After weeks of frustration, he told me he wished that he could dream up something better. He likes to operate 160 meters, as well as the other bands, but his support poles were only 140 feet apart. Then one night, about 2:00 a.m., I awoke from a fitful dream with an idea buzzing around in my brain: Why couldn't the extra footage needed for 160m be made up by using *in series* the three wires (one white, one bare, one black) in Romex™ cable, the non-metallic-sheathed cable used in house wiring?

I chose 14-gauge wire because of its lightness and low profile against the background of sky and trees.

This arrangement gives a flattop length of 420 feet, certainly ample for 160m. I had no idea exactly what would happen regarding impedance and frequency with the leads folded back upon themselves, but in our desperation, it seemed worth trying. The flattop dimensions and lead-in length were simply dictated by the limitations at Gene's QTH.

With the help of two fellow hams, Gene got busy acquiring the components and getting the antenna up. The following day he fired up on 75 meters for our regular schedule, after determining that his antenna gave him a 1:1 standing wave ratio on all bands. Lo and behold! His signal now was very strong (S9+) in spite of the fact that he was running only his exciter. Switching back and forth, he got greatly improved reports over the "Rattlesnake" from all who called in. I urged him to try the antenna using his linear amplifier, but he was afraid the high power might puncture the insulation of the flattop leads lying so close together. Finally, after several days, he held his breath and turned on the high power. What a beautiful signal—S9+30—and no arc-over! He immediately started calling the antenna the "Cobra," because it had a much more powerful "bite" than the "Rattlesnake."

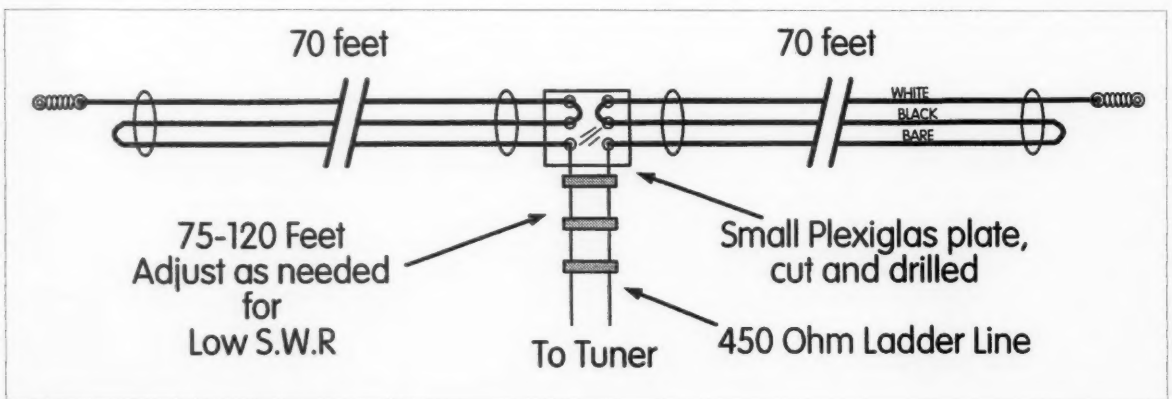

***Fig. 1**. The configuration for the "Cobra."*

I then erected a "Cobra" at this QTH, using an Alpha linear, with the same results—because I, too, wanted to get on 160m. My previous antenna flattop was 108 feet long using traps. Emmett Bishop W4JVI of Athens GA, who regularly calls in, became excited about trying the "Cobra." He had been using two separate antennas of standard design, but his signal was often so weak (even with the linear) that Gene and Lloyd Goodwin W4FFD, in central Florida, could hear him faintly, or not at all, at that time of day on 75 meters.

After a few days, Emmett called in using his new "Cobra." His signal was S-9 with the exciter only, a far stronger signal than he previously had using both exciter and linear. Gene and I had checked the antenna out on other bands with excellent results, but Emmett had not yet had the opportunity to do so. This setup, of course, requires the use of a tuner for low SWR and efficient operation on all bands.

Some of our more skeptical, and perhaps knowledgeable, friends have expressed concern about impedance, power rating, wave-cancellation, etc. All that we can offer as an answer is the slogan used for many years by the Packard Motorcar Company: "Ask the man who owns one."

For years I have used the individual wires in three-wire conduit for antennas. At ten cents a foot, it's three hundred feet of antenna for ten dollars, or three cents per foot for the separate wires. Why not try this antenna? As Gene says, "I'm just tickled pink with the 'Cobra.'" Perhaps you will be, too. 73

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LDG's QRP Auto Tuner

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Jeff M. Gold AC4HF
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There has been one shack accessory I have been longing to own since I got rid of my tube rig—an automatic antenna tuner. I was very excited to get hold of a solid state rig and not have to load up the transmitter when changing bands. I have to admit it: I may be getting older (and lazier), but I never got much enjoyment out of fiddling with a bunch of knobs every time I changed bands. My first attempt at handling this problem was to get mostly resonant antennas. I have a five-band quad, a seven-band vertical, and a resonant dipole for 160 meters. I found early on that using my quad and a manual tuner I could also work 30, 40 and 80 meters. Not only could I work them, but I seemed to do quite well. The vertical also worked well, but on 40 and 80 you really need a tuner to go from one end of the band to another.

My next attempt at handling the problem of having to mess with a bunch of tuning knobs was to get hold of an older solid state tuner with a built-in automatic tuner. I ordered it, used, by mail. The rig worked great, I really loved it, but the tuner didn't work right. I managed to work a deal with the person I purchased it from and kept the rig, but still had no automatic tuner available. I thought it too expensive to get it fixed, and even if I got it fixed, I would have an older tuner that worked on only one of my many radios. I usually have at least six radios on line, hooked to three different antennas.

The folks at LDG Electronics solved my main problem: They came out with the AT-11, a 100-watt automatic antenna tuner. I was able to set it up to have all my rigs on line with all my antennas and use this one tuner. It's very fast and matches any of my three antennas on 10-80, and the dipole on all bands I have tested so far. It works for rigs down to about two watts and has exceeded all my expectations—and the best part was that I purchased the AT-11 in kit form. The kit is made up of excelient components and the matching case is very nice. I enjoyed putting the kit together as much as I've enjoyed using the auto tuner.

I work mainly QRP (low power) both on SSB and CW. I also love to work portable operation. I recently purchased a used Index Labs QRP+. This great little rig works 10-160 and has memories, SCAF filter and a built-in keyer. I purchased it mainly to take hiking in the Smoky Mountains. I love to pack up a rig, a small gel cell and portable wire antenna; I hike for an hour or two, and then set up my equipment. The thought of a small, low-power automatic tuner really got me thinking of how nice it would be to not have to mess with my old small manual tuner.

Hallelujah!

LDG's QRP Auto Tuner is offered as a kit or fully assembled. I bought the kit. It's a full-featured tuner that can be used either in automatic mode or semi-automatic mode.

In automatic mode, when you move around the band, or you change bands and the SWR gets too high, the auto tuner will start tuning. In semi-automatic mode when you want to re-tune, you simply push a tune button. The QRP Auto Tuner uses a switched L configuration with 256 capacitor, 256 inductor and Hi/Lo-Z settings to provide over 131,000 tuning combinations.

This tuner works well with about any coaxfed antennas (dipole, vertical, beam, etc.). Tuning time has been improved over the higher power version to between 0.1 seconds and 3.0 seconds with an average time of about 1.5 seconds.

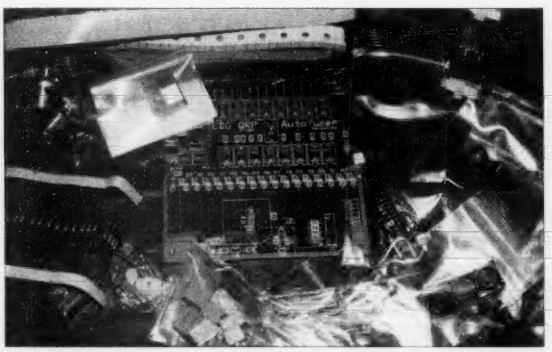

Photo A. *Unassembled kit.*

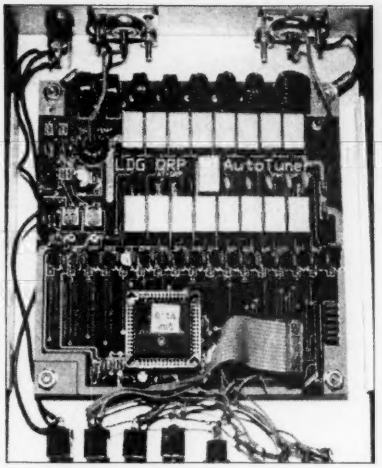

***Photo B.** PCB mounted in case.*

The QRP Auto Tuner uses four LEDs to indicate the SWR status. Green indicates that the SWR is less than 1.5, green/yellow is 1.5-2.0, yellow is 2.0-2.5, red/yellow means 2.5-3.0, red indicates the SWR is over 3.0. There is a fourth LED used to indicate the tuner is in tune mode.

The kit

The QRP Auto Tuner kit is top quality in every sense. There are a lot of soldering joints, but many of them are the same value component, which meant I spent lots less time looking for parts. The parts came nicely packaged, and all parts were good quality. The printed circuit board was excellent. It was clearly marked and was plated through and solder masked. I got the optional case. I hate to drill lots of holes in a case when I am done building. The case makes the finished product look very professional.

The instructions were clear and easy to follow. There is a very nice parts overlay diagram that makes it easy to get the parts in the correct place. It is *very* important that you carefully read through the directions before building. There are some key areas that must be built in the described way or the unit will not work correctly. The included diagrams clearly show you how, but it is very easy to skim through the directions and not catch key details. LDG did a really good job with the instructions, and if you follow them the unit will work well.

After building the higher-powered version I opted to proceed a little differently from the directions—however, I followed every step exactly according to the cautions in the directions. I wound all the coils first. The directions for this were easy to follow. You will want to note the provided figures (Fig. 2, Fig. 3, Fig. 5 of the instructions) to make sure you wind the coils correctly. Note that with the first four coils you go through the toroid from the back, because the coil windings are all on the bottom. L5-L8 you start from the front. You wind them all in a clockwise direction. If you wind them wrong they will not fit correctly in the board. You don't solder these until later. I like this approach. I find I usually wind coils much better at the beginning of a project than when the whole board is ready to go and all you need to do is finish the coils. Also, please note the L8 is a double toroid. It uses toroids and you wind the wire around both of them—clearly explained in the instructions, but if you tend not to read directions completely, as I have sometimes done, you might miss this. The winding of the toroids must be done as described in the instructions.

Next, the directions tell you to mount parts on the board starting from

***Photo C.** Front view.*

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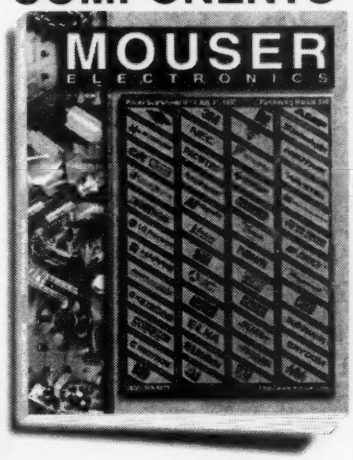

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the components that are closest to the board. I usually like this approach. With this project there are some holes that are very close together and it wouldn't be too hard to accidentally fill the nearby hole with solder. For this reason I started with the components under the bottom row of relays. If you look at this section there really are sets of three components that repeat across the board. There is a 1k resistor, a 0.01 capacitor and then a 2N3904 transistor. I stuffed these in the board and soldered in sets of three, checking each set before proceeding. I followed the rest of the directions pretty much as they were stated.

Once you have placed and soldered all the parts, you test the unit without the processor chip installed. The chip is the most expensive component, so I liked this idea. You need only check for +5 volts on the output of the 78L05 regulator. If the volts look good and the unit isn't pulling too many amps you stick in the chip and turn on the power. If everything is OK, all the LEDs blink once to let you know the unit has checked itself out.

The alignment of the unit is very simple. You only need a voltmeter. You simply apply 5-10 watts into the unit and zero the voltage using a variable capacitor. Once this is done you set both the forward and reverse voltage to 2.5 volts at the specified test points. The whole process can easily be done in a few minutes. After I got done with the alignment and was pretty sure things were doing what needed to be done, I glued down the first four coils as suggested and also put a dab of epoxy on the LEDs to hold them firmly in place. I then put the case top on.

Testing the tuner

I took the little QRP Auto Tuner over to my workbench and took my connections off the tuner's bigger brother, the AT-11, and prepared for testing, using a small 12V gel cell for power. My workbench setup allows me to choose any of six transceivers and match it with any of my three antennas. For initial testing I used my 160 meter dipole, my Gap vertical, and my Lightning Bolt 2-element, 5-band quad (10-20 meters).

I used five watts and keyed up. The QRP Auto Tuner was set on automatic mode, so that when you key up, if there is an SWR mismatch, the tuner activates. The relays clicked for less than one second and matched the 160 meter antenna for 40 meter operation. I was able to tune this dipole (resonant at about 1. 850) to all amateur bands. The tuner also tuned the Gap vertical to all bands, including 160 meters. It tuned the quad to all bands down to 80 meters. I played with the unit and if the SWR was less than 1.5:1, I was able to use the capacitor and inductor switches to get the SWR pretty much down to close to 1:1.

X-treme test

This is the kind of a story I live to tell. My goal in building LDG's QRP Auto Tuner was to be able to use it with a small dipole I use when I'm hiking. The antenna has been cut to be a resonant dipole that covers the 20-meter band. I used a six-by-six inch piece of Plexiglas™ as my center insulator (and wire holder). I used small cloth-wrapped stranded wire that tends to be kink-resistant for the antenna. For the coax I used very small RG-178 coax. Both legs of the antenna and the coax wind nicely around the Plexiglas while I am hiking and allow me to set up the antenna very quickly when I arrive at my destination.

I took the antenna and set it up in the middle hallway of my house, the worst in-the-house location I could think of. The antenna was hung approximately four feet off the floor with the wire just draped over two doors. I brought the coax into the shack and hooked it up to my TenTec Argosy II. I powered the Argosy with a small gel cell and was in QRP power range.

The weather here in Tennessee was awful—heavy rains and severe thunderstorms. The bands were horrible, with lots of static crashes and not many stations on. I went through the bands from 80 to 20; the only stations I heard were on 40. I keyed the transmitter and in less than one second the dipole was tuned. I looked around for a while for a station calling CQ. I finally came across Dan K9EUV, in Mishawaka, Indiana. He was a 599, and gave me a 339 report. I admit we didn't have a long QSO, and he did have trouble copying, but we exchanged calls, names and QTHs. Considering the power I was using and the antenna strung up in the middle of my house, I still have no idea how I got out.

I checked the SWR on 20 meters with my MFJ antenna analyzer. The SWR in the house was over 5:1 to start with. The little QRP Auto Tuner had no problem tuning the twenty meter dipole on 10, 20, 30, or 40 meters. It tuned each of these bands in less than one second. I am really looking forward to taking this tuner, my QRP+, and the dipole hiking. I'm sure I'll have no problem once I get on top of the mountain. This auto tuner is much smaller and lighter than the manual tuner I've used in the past.

Bottom line

I am very impressed and more than satisfied with this tuner. The QRP Auto Tuner tunes more quickly than the AT-11 version in all tests I have performed. It was a great kit to build and it works fantastically.

To order, contact LDG Electronics, 1445 Parran Road, St. Leonard MD 20685. Phone (410) 586-2177; [ldg@radix.net] or [http//www.radix.net/~ldg], or send $100.00 for the kit, plus $6.00 shipping (US and Canada) to LDG's sales department ($125.00 plus $8.00 for the kit with enclosure; $159 plus $8 shipping for the already-assembled model).

Specifications:

- Size: 4.4 x 4.3 x 0.6
- Weight: 4.2 oz.
- Configuration: Switched "L" network
- Inductor range: 20 µH
- Capacitor range: 2700 pF
- Tuning time: 0.1 to 3 seconds, 1.5 average
- Current consumption: 10 to 190 mA, 75 mA average
- Voltage requirement: 11 to 14 volts
- Microprocessor-controlled
- 30.0 MHz coverage
- Tunes 6 to 800 ohm loads
- Power range: 0.1 to 10 watts
- For dipoles, verticals, vees, beams or any coaxfed antenna
- Kit builds in 2 to 4 hours (average) 73

73 Review

ICOM IC-R100 Communications Receiver

It may look like a scanner, but it is a serious communications receiver with scanning capability.

Breckinridge S. Smith K4CHE
104 Brookfield Drive
Dover DE 19901

I like scanners, but my wife is obsessed with them. She has two in place on the kitchen table, one to monitor the community and another one to keep track of the police departments and my ham activity. It's a regular scanner world in our kitchen. The last time the President visited the nearby Air Force Base, our kitchen sounded like a military command post.

I searched all of the advertisements for a small receiver/scanner with good sensitivity, a VFO, and an S-meter. These specifications were needed for my foxhunting sessions using Doppler systems and conventional directional finding antennas.

I had a lot of trouble getting some of the manufacturers to fess up on their sensitivity specifications but ICOM specs were clearly stated in their spec sheet. So I ordered the unit and received a small (5.9 inches wide, 2.0 inches high and 7.1 inches deep) unit that conformed to my specifications, as well as featured a built-in 20 dB attenuator and a preamp. Throw in the wide 500 kHz to 1800 MHz coverage and you have quite a unit. Yes that's correct, that's 500 kHz, which is down below the AM broadcast band, up to 1.8 GHz, which is in never-never land. Now *that's* coverage. The standard receiver coverage is continuous and covers all the amateur bands including HF, VHF, UHF up through 1296 MHz. The unit, as supplied, does not cover 800 to 900 MHz—there is a special law enforcement receiver that can be ordered by authorized agencies that covers 800 MHz.

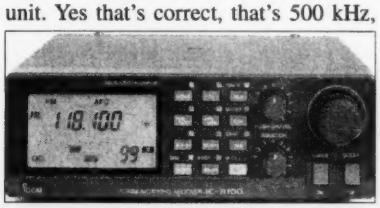

***Photo A.** The ICOM IC-R100.*

I unpacked the unit in the kitchen while my wife eyed it from across the room. Was she thinking of a third unit to add to her inventory? She doesn't know about the predicted frequency move of our local agencies from VHF to the higher frequencies—I know *your* area agencies have already moved from the lower bands to 800 MHz or higher, but I must remind you that I live in the technical black hole of the East Coast—Delaware.

Initial examination

The first thing you notice is the 3.1-pound weight; the unit feels hefty. The entire enclosure is steel, not plastic, and on the rear are three antenna connectors. Remember, I told you that this is a serious receiver. Two N connectors for the 50.0 to 905 and the 905 to 1800 MHz range: You need two antennas for these ranges. The third connector is an SO-239 and is for the lower frequencies of 0.5 to 49 MHz. The antennas

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supplied were a small telescoping whip with an N connector, and a short portable longwire HF antenna. After further examination of the rear panel I found the standard 2.1 mm power plug. The center pin is positive (don't you hate it when they make the center pin negative?), and a quick check of the service manual tells me that the unit has reverse polarity protection via a diode. There's an internal speaker mounted on the bottom, but the unit has an external speaker jack which utilizes a 3.5 mm plug. In addition there is an antenna select jack which uses a 3.5 mm stereo plug. The rear panel also sports an LCD contrast pot and a clock display option switch. The data plate is riveted to the chassis. The power cord is fused on both sides (don't buy equipment that is not fused on both lines—I can tell you some horror stories!). ICOM provides a chassis-mounted metal cable clamp to keep the power cord secure. The mounting bracket supplied is rugged and secures the unit with four screws.

The biggest item on the front panel is the large 2- by 1-inch LCD display. There is a no-nonsense dimmer button that is easy to activate. The keys on the keyboard are covered with that magic rubber and the function labels are printed on the rubber. The actual key numbers are printed on the front panel. Key activation is signaled by a beep (which can be disabled). The squelch and volume knobs are much smaller than the large VFO/channel knob, which is normal-sized. Below the VFO knob are two push-buttons which are labeled timer and sleep. At first, I thought "What a waste of panel space," but these buttons are also labeled DN and UP and allow you to change the frequency or channels up and down if you get tired of the large VFO knob.

Sensitivity and frequency coverage

My first bench check was for sensitivity. If the unit doesn't pass, it goes back. On two meters the specs called for 0.2 µV using 12 dB SINAD. I measured 0.1 µV without the preamp. The squelch opened at .07! This was without the preamp on; turning on the preamp on two meters did not really improve the 12 dB SINAD sensitivity, but the S-meter indicated an increase in signal strength. The sensitivity passes and the unit stays. My Doppler systems and other DF gadgets on my communications van are going to be very happy with this receiver! Further sensitivity checks on 220, 440, 906, and 1296 all beat the specs, but the preamp has to be on for the higher UHF frequencies—above approximately 500 MHz—to meet the specs. On its spec sheet, ICOM clearly states that the preamp must be on to meet specs between 50.0 and 905 MHz. The preamp is not available above 905 MHz, and you have a slight rise in the 12 dB SINAD specification level from 0.2 µV to 0.32 µV on FM which results in the receiver sensitivity being slightly reduced. I spot-checked the FM sensitivity at 1550 and 1750 MHz and found it to be better than the specification of 0.32 µV.

"Remember, I told you that this is a* serious *receiver."

Unit operation

Setting in a basic frequency and mode was simple, but you have to be careful with the selection of the mode. It's easy to confuse the wide FM with the narrow FM. Wide FM would be used on the FM broadcast band or in the audio portion of TV broadcasting, but not on two meters. It took only a moment to program the channels, but the best part is that you can erase the channels completely without resetting the central processor. I was eager to try out the VFO and found that the tuning step range of the VFO was easy to change. The selectable steps are 25, 20, 12.5, 10, 9, 8, 5 and down to 1 kHz. I was looking forward to the 1 kHz steps, which are needed for foxhunting when the fox sometimes shifts, either accidentally or on purpose, off frequency in small increments. The mode and step setting are programmable with the channel frequency and it's easy to select a channel and then tune up or down in small frequency steps from the channel that is selected. The first week that I had the unit I drove around town tracking down cable TV leaks for DF practice. With the IC-R100's VFO it was a snap. During my tour of the city I drove through several of our intermod alleys and found the receiver to be reasonably immune to overload as compared to the other (cheaper) scanner mounted in the vehicle.

More receiver features

The attenuator is selectable with a push-button and provides approximately 20 dB of attenuation. This is very useful near strong broadcast stations, repeaters, and when closing in on the fox during a hunt. This feature is available only on the 50 MHz to 905 MHz range.

The AFC (Automatic Frequency Control) tracked very nicely. I set the unit on the bench and slowly moved the signal generator away from the frequency and the unit tracked it. Perfect for that foxbox or balloon transmitter that drifts in frequency, due to low batteries or extreme temperature change.

The antenna selector jack is located on the rear panel. The instruction book was vague on this function but the purpose of this jack is to provide a high or a low voltage logic signal depending on the frequency that is being covered. This logic signal will be used for activating other antenna selectors remotely. The instruction manual didn't include a table of voltages but it was easy to figure out.

The unit has a clock which can be displayed on the front panel if desired and you can program the unit for various timing functions. Available are power on, power off, or a memory select timer. You can have a once-only timer, a daily timer, a sleep timer—the list goes on. The clock has a backup battery specified to last one and a half years, and it's fairly easy to access the clock battery, as it is located on the main board, near the rear of the receiver. The central processing unit also has a battery that has a predicted life of five years and ICOM recommends that the receiver be serviced for this battery change as the battery is buried in the logic board area.

The S indicator is a bar graph with seven easy-to-read segments. It is a relative signal strength indicator, and is not calibrated in S units. During the factory alignment, the S indicator is set at a specific signal level in the 80 MHz range. A three-segment signal indication on VHF is not the same as a three-segment signal on UHF—I found that for three segments, on two meters it took 1.5 µV, and on UHF it took a much stronger 7 µV volt signal.

I took a break from the test bench and put a wire antenna on the HF antenna port.

Tuning down across the 40-meter AM broadcast band was a treat! I had forgotten about the hundreds of stations broadcasting from all over the world. A quick check on 40-meter SSB and CW produced signals with the receiver, but they were hard to interpret as the unit does not have a BFO or product detector. Tuning across the AM section of 75 meters produced several good signals. Checking the time and frequency standard, WWV produced strong signals in the 10 and 15 MHz range. While mobile, I used the ANL, automatic noise limiter, on WWV, and found it to be effective with pulse-type noise.

Back to the bench

The ultimate test of a scanner: The Birdie Search. The search is conducted without an antenna for signals that are produced by internal mixing of various oscillators and IF circuits inside the receiver. Nothing is worse than band-scanning and having your unit lock up on one of these internally generated signals. My first problem: How do I check the receiver from 500 kHz up to 1800 MHz? That's a lot of knob twisting. What I did was program the unit to search small frequency segments at a time, and to stop and resume scanning. I activated the Auto Memory Write Scan mode; this way the receiver would search itself and write any detected birdies into channels 80 through 99. I went back later to check the results. I did find a few, but very few—one well below two meters on 141.2 MHz and other significant signals at 105.9, 176.5 and 211.8 MHz, but not enough to worry about. There were no birdies in the amateur bands; this unit is very clean and passes the birdie test. The auto memory write mode worked very well and is great for searching with an antenna for those secret frequencies out there.

800 to 900 MHz is locked out of the receiver. Now, I know that some of you want to know about the possibility of modification, to receive this range for monitoring local government agencies. Since I do two-way radio service work on the local trunking channels, I needed the extended coverage to monitor our systems. I modified the unit using one of those modification books that are available at hamfests. The modification wasn't easy and involved a complicated disassembly of the unit to be able to find the correct area of the logic board. Once you find this area you have to remove several surface-mount components surgically. The modification is definitely not a clip-the-diode or jumper type of operation.

The instruction manual is well written and provides several quick reference sections. A schematic of the unit is not included. ICOM promptly sent me a service manual for review; it was well organized and included all the schematics. During my review of the service manual I stumbled across this "Danger" statement: *"Do not apply an RF signal of more than 100 mW (that's one tenth of one watt) to the antenna connector. This could cause damage to the receiver front end."*

With the IC-R100's VFO, tracking down cable TV leaks was a snap."

I did some field strength calculations but was not sure of the near-field formulas so I tested my scanner receiver antenna mounted in my van. It was very easy to induce a 100 mW signal into my scanner antenna from a nearby 50-watt quarter-wave antenna. Most of my power levels on my vehicle are in the 10- to 25-watt range so I was fairly safe. My advice is to mount your scanner antenna as far as possible from any transmitting antenna—this is good advice for *any* two-way installation. Separate those antennas!

Overall

It's obvious that I like this receiver. My only complaint is that the unit has too many features crammed into the little steel box—but all the features work, and the unit surpasses its published specifications. I have used the unit extensively for my two-way radio service work and for my foxhunting obsession. I don't think that you will be able to find another small mobile receiver that has the frequency coverage, a VFO capable of 1 kHz increments, and a preamp and attenuator built-in.

MSRP for the blocked version of the IC-R100 is $960. For further information, contact ICOM America at 206-450-6088 or your nearest ICOM dealer. 73

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73 Review

The Standard C108A

It's the smallest amateur HT available today.

Dean Lewis WA3WGV
1193 Azalea Lane
Palatine IL 60074

Photo A. *Standard's C108A.*

Two-meter ham radio hasn't been this much fun since my first Heathkit "Twoer," over 30 years ago. Owners of Standard Amateur Radio's C108A pocket-size two-meter HT already know that the rig *really* fits in a shirt pocket, has excellent sensitivity, and is easy to use. I agree with those who say it doesn't replace a higher-powered unit in all cases, but don't let the 230-milliwatt transmit power deter you from getting one. It does work local repeaters, has excellent transmit audio, and the small size (only slightly larger than a pager) means you can take it with you everywhere. The following suggestions are based on over a year of successful use of the C108A; some should also apply to Standard's dual-band version, the C508A.

Operation

The 7 buttons (called "keys" in the owner's manual) are easy to operate. We're used to instant response from push-button switches, so the Power key takes a little getting used to; it must be pressed and held for a fraction of a second before the unit turns on. After a while you develop a routine for handling the rig without hitting any keys when clipping it to or removing it from your belt.

The belt clip is an extra-cost accessory. If you buy the soft case and belt clip at the time you buy the radio, I'd suggest not using both at the same time for a few days, until you get used to the button functions. They're not printed on the soft case, and with the clip installed, it's difficult to slide the case down to see the labels next to the keys. After a few days' use, the functions become intuitive. While on the subject, a word about the belt clip. Although stronger, heavy-duty, and non-rotating, it's similar to a speaker-mike clip. It clips onto your belt, not around it like a pager or most HTs. It's very secure, and does not slide.

Scanning is an excellent way to find new repeaters and popular local simplex frequencies. No matter what portion of the radio's broad frequency coverage you want to scan, you'll appreciate the two types available, defined by how long the receiver stays on an occupied frequency before moving on.

If you move around a lot from one end of the frequency range to the other, you'll soon catch on to a method for doing it quickly: switch to the largest (50 kHz) tuning step before dialing to the new frequency, then switch back to the step desired for scanning or tuning within that frequency range.

Rather than an analog knob for setting the squelch, three squelch positions are programmable and are easily changed: high, low, and off. The high and low designations are opposite to what I would have termed them. Think of it this way: the high setting requires high signal strength to open the squelch; at the low setting, even low level signals will come through. I initially had misgivings about the automatic squelch settings, but those doubts were quickly put to rest. I don't know how it's done, but the "low" setting is every bit as sensitive as a manually-set squelch control; if the squelch does not open, you can be assured there's no usable signal there. Provision is made for manually overriding the squelch if you need or want to. Now I wish all HTs had the automatic feature—one less control to mess with.

Once you've programmed the memories, dialing through them is enhanced by a beep at memory location zero—very handy when you can't be distracted by watching the readout, such as in a dark location (although the backlight can be switched on) or mobile with the rig on the seat next to you. From the beep, count the knob detents, and you know which memory position you're on.

The 108 doesn't include an S-meter. This has caused some owners concern when trying to identify the exact frequency of a strong signal, either simplex or an unknown repeater. But a very strong signal which appears on more than one frequency will appear on an *odd* number of frequencies; the center position is the true received frequency.

Frequency coverage

Although the unit transmits only in the two-meter ham band, it receives from 100 MHz to 174.995 MHz. This includes some interesting territory—aircraft, marine, the Coast Guard, public service, police, fire departments, and NOAA weather radio. In addition to giving you tomorrow's forecast, the NOAA signals are good for catching band openings during the tropo season.

The owner's manual does not explain AM reception. The 108 automatically switches to AM from 100.000 to 138.330 MHz, and a decimal point appears in the readout to the right of the last full-size digit, a "10 kHz dot" in the nomenclature of the manual. There is a dead band from 138.335 to 139.995 MHz, in which no signals can be received; the readout flashes on and off to warn of this condition. AM cannot be enabled elsewhere in the range of the 108's frequency coverage.

Antennas

The 108's antenna connector is an SMA type, due to insufficient space on top of the radio for a BNC. You'll need

an adapter if you plan to connect any BNC-fitted cables or other antennas. Shop around; I found prices for an SMA-to-BNC adapter varied from around $30 (!) down to just under $7. Whenever using the adapter, be careful to avoid mechanical strain on the antenna fitting or the top of the radio. Connect the adapter's BNC end to the antenna before threading the SMA end onto the HT, and match the threads carefully.

Your choice of antennas at any given time will be determined by the need at the moment. The antenna will configure your 108 for either (1) effective communicating, or (2) carrying convenience. These are described in the paragraphs following. The rubber ducky supplied with the radio is a compromise between the two.

(1) Many of us use a 2-1/2 to 5 watt HT feeding a short rubber ducky, whether for simplex contacts or through local or medium-range repeaters. If better range is needed, we get an HT (or battery) with more power. Bad logic. The antenna is just as important at 2 meters as it is at HF. Sure, a 4-inch "stubby duck" is convenient and it will make contacts, but to get the most out of a 1/4-watt HT, get used to using a better antenna. Connecting a telescoping endfed 1/2-wave (an AEA HR-1 "Hot Rod") made a tremendous improvement in both my transmit and receive coverage, and it made the difference in my satisfaction and success with the 108. But be careful handling the radio with a long antenna connected. The fitting and the top of the radio are not built for the kind of mechanical strain you can cause. Keep the radio upright, protect it from tipping over, and don't walk around indoors (or outdoors under trees) with the antenna extended (and, as with any HT, don't make yourself a lightning rod outdoors in threatening weather).

I've also had great success with a trunk-mounted 5/8-wave for mobile use, even at this low power level. For travel with a rented car, a small mag-mount 19" whip was recommended to me by another owner who was very satisfied with the results.

(2) At the other end of the antenna size range, shorter models are best for carrying the HT, and will make the most of its small dimensions. "Mini-ducks" available from several suppliers (Comet CH-32, Diamond RH-3, Optoelectronics DB-32; possibly others) are 1-3/4" long, including the BNC fitting. You have to use an SMA/BNC adapter which adds a bit to the length, the antennas are not flexible, and they're often referred to as dummy loads. They are, however, very convenient when carrying the HT on your belt. They work surprisingly well for receiving, and they're great for Field Day or hamfest simplex—you can even work repeaters if you're close enough. More recently, these mini-ducks have become available with SMA fittings (Comet SMA-501, Diamond SRH-805), and don't require the SMA/BNC adapter.

For even greater convenience when just carrying the rig, disconnect the antenna, put it in your shirt pocket, and screw an SMA cap on the 108's antenna fitting. At this point the radio is as convenient as a pager (and is often mistaken for one), the antenna jack is protected from dust, moisture, and any stresses from the antenna, and the antenna itself is protected. If you're going to carry the rig in a coat pocket, especially in bad weather, this is the way to do it. Remember not to transmit without an antenna connected!

Batteries

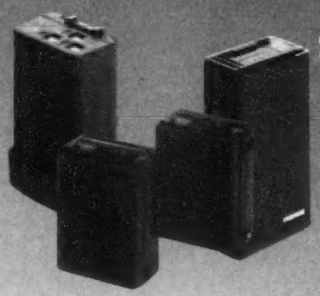
The C108A runs on two AA-size batteries. They last a long time in receive; I run name-brand alkalines for several hours a day for over a week between battery changes. Transmitting time has, of course, a significant effect on battery life. It's a good idea to carry spares. Radio Shack carries a white plastic battery clip for two AA cells, the type that has a 9-volt style connector at the top (part number 270-382). Remove the metal hardware, and the plastic holder keeps the two batteries together and protected from shorting out on metal objects.

Batteries too depleted for transmitting often have plenty of life left for receiving. It can pay to hold on to your weakened batteries for additional hours of monitoring.

I'd recommend buying the protective soft case for the radio. Besides protecting the unit, it helps keep the battery cover in place, especially when clipping it to your belt or removing it. The more recent, dual-band C508A has a lock on the battery cover which the 2 meter-only version doesn't.

Yes, I do own a higher-powered HT, but the C108A is the one that's always within reach. It's about the size of the mike that came with that old Twoer.

Note: SMA caps are very difficult to find. I had to buy a quantity in order to get one, and can supply them for $5 each. 73



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What's a ham to do? The new FCC regulations require that hams running more than 50 watts PEP must conduct a routine RF radiation evaluation to ensure that the radiation is within the maximum permissible exposure limits. A spectrum analyzer with calibrated antennas can cost many thousands of dollars—but it is my understanding that the measurements need only be accurate enough to ensure that the limits are not exceeded. This leaves a lot of leeway in most cases.

At W6YBT, we use only indoor antennas. For this reason, the new FCC ruling is of special interest. So what should I do? In general, I don't like the hand-held E field meters. I once had one that measured the 60 Hz fields from fluorescent lights when it was *supposed* to be measuring RF. The secret of measuring the field strength close to a transmitting antenna is to measure the magnetic field, not the electric field. This is done with a loop antenna.

The requirements for a loop antenna suitable for RF radiation evaluation:

1) Use only passive components. We don't want an unstable RF amplifier or a drifting DC amplifier.

2) The unit should be easily duplicated by other hams.

3) Since the loop's sensitivity is determined by its dimensions, only the sensing unit needs to be calibrated. This can be done with an ordinary laboratory signal generator.

Construction

Go to a toy store and buy a standard 79 cm diameter hula hoop. Get the cheaper one with the three ball bearings inside, not the one that can be converted into a jump rope. Remove the staples and the center plug but don't cut off any of the tubing. Next, cut a 98-inch length of RG-8/U and remove a 1 cm section of the braid at its center. This break in the braid permits the sensing of magnetic fields while retaining shielding from electric fields. Loops always measure the magnetic field. They are, however, usually calibrated to indicate the equivalent electric field in volts per meter.

Now thread the RG-8/U through the hula hoop and install PL-259 connectors on both ends. Cut about a quarter of an inch off each end while installing the connectors. Be careful to make good solder connections to the braid (you will need a 100-watt soldering iron for this). After soldering, take some alcohol and clean off all the rosin. Even a small contact resistance can result in erratic readings.

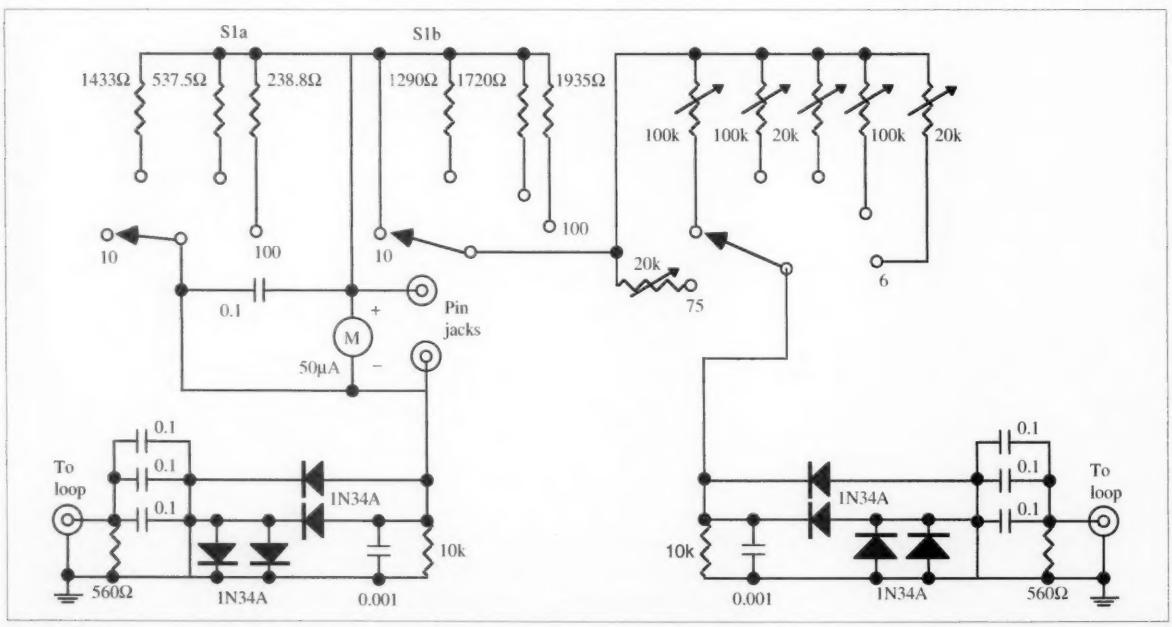

Fig. 1. *Only passive components were used—no batteries to replace!*

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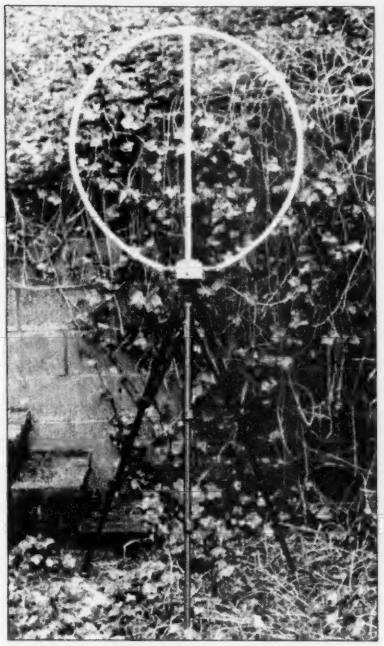

Photo A. The box mounted on the camera tripod.

When the loop is completed, the hula hoop should just cover all of the black jacket on the RG-8/U—it is important that you follow these dimensions exactly. The sensing unit is built into a Bud™ CU-234 die-cast aluminum box. I installed SO-239 connectors to support the loop. Be careful not to run any rosin into the connectors; they permit the loop to be removed for calibration of the sensing unit.

I bolted a piece of white three-quarter-inch PVC pipe to the rear of the box, and inserted a short piece of three-quarter-inch dowel into the end of this pipe to prevent the screws from mashing it. At the upper end of the pipe is a tee through which the hula hoop is threaded (the inside of the tee had to be filed to permit the hula hoop to pass through). As a final touch, I drilled and tapped the box for a 1/4 - 20 screw to mount it on a camera tripod (**Photo A**).

The circuit (**Fig. 1**) uses a 50 microampere meter (Micronta 270-1751). It is shunted to provide four sensitivity ranges. In order to provide a constant load, the range switch also adds series resistors. I used ordinary quarter-watt resistors selected with a digital ohmmeter. The odd values were made by connecting two resistors in series. Be careful not to overheat the resistors when soldering.

The shunt values were calculated for use only with the 2150Ω Micronta (or other 2150Ω) meter. Unfortunately, Radio Shack™ no longer sells this meter. The Simpson 1227 50μA meter is a suitable but more expensive substitute. You should add a 350Ω resistor in series to bring its 1800Ω resistance up to 2150Ω.

A major problem was getting sufficient

Band	75	40	20	15	10	6
Cal. Volts	0.55	1.28	1.72	0.64	1.22	0.33
Trimmer R	10.6k	43.6k	65.9k	15.7k	40.8k	4.0k

***Table 1.** Reference points that you can use for approximate calibration of your hula hoop. An ordinary laboratory signal generator will provide a standard calibrating voltage point for each band.*

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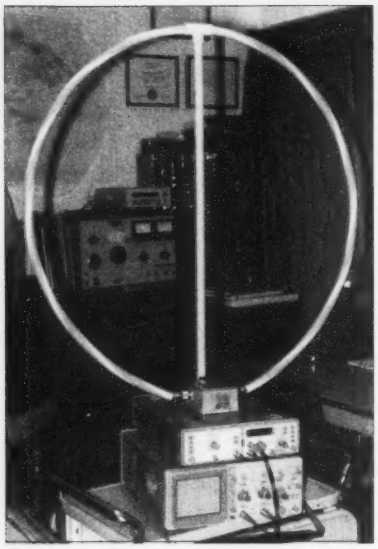

Photo B. *Calibration was done by substituting the hula hoop for a standard calibrated loop located on top of a spectrum analyzer. The signal generator in the background was used to establish a calibration reference point for each band.*

sensitivity on 75 meters because loops are always less sensitive at lower frequencies. This required the use of capacitors and clamping diodes in addition to the conventional half wave rectifiers. The diodes were selected for high back resistance using the x100000 scale on my Triplet 630A meter—I threw away any diode that measured below 1 megohm. Use a clip-on heat sink to avoid overheating the diodes when soldering.

A separate calibration trimmer potentiometer is required for each band due to the differences in loop sensitivity. I ordered the Spectrol trimmer potentiometers from Mouser™. You will need three of the catalog number 594-70Y203 and three of the 594-70Y104. The switches came from Radio Shack. They are 275-1385A and 275-1386A. All of the capacitors are 500 volt or 1kV ceramic discs.

Calibration

Preliminary calibration was done with a spectrum analyzer and a calibrated loop. I used my Yaesu FT-757GX and my indoor antennas as a signal source (**Photo B**). First, I took a reading with the standard loop on top of the spectrum analyzer before replacing the standard loop with the hula hoop and setting the calibration potentiometer for that band. Due to the complicated field distribution inside the house, this calibration was only approximate. For the final adjustment, I used outdoor wire antennas.

After calibration, I removed the loop from the sensor unit and connected my signal generator and a 6 dB splitter in its place. The splitter output ports must both be terminated with 50Ω loads. I then determined the signal generator output required to give a reading of 10 volts per meter on each band (see **Table 1**). You can use them for calibration of your sensor unit. I have also listed the approximate trimmer settings for each band. Be sure to switch out the trimmers before measuring their resistance. You'll most likely prefer the signal generator method of calibration because it will enable you to correct for differences in diode characteristics. The trimmer settings will not.

The response is nearly linear. However, the line doesn't pass through zero, so use the graph (**Fig. 2**) for accuracy. If you are an artist, you might want to calibrate the meter face. I chose meter ranges of 10, 25, 50, and 100 volts per meter, since it is best to read only the upper half of the meter scale. The calibration trimmers were all set in the upper portion of the 25 V/M range in order to provide the best accuracy for the FCC 27.5 volt per meter limit for uncontrolled environments. Don't use the calibration graphs with the 50 or 100 V/M scales—reading the meter scale directly will give better accuracy.

It is unlikely that you will use them anyway. The highest reading that we were able to get from a kilowatt with a beam was only 10.6 volts per meter. I should emphasize that this is not intended to be a precision instrument. It is most useful for measuring signals that are well below the FCC limits. If you get a high reading, use a more precise instrument or better yet, locate and correct the cause of the high reading.

Extending the frequency range

Due to the high distributed capacitance of RG-8/U the hula hoop will not work on 10 meters. A small loop made from a 35-3/4" length of RG-8/U

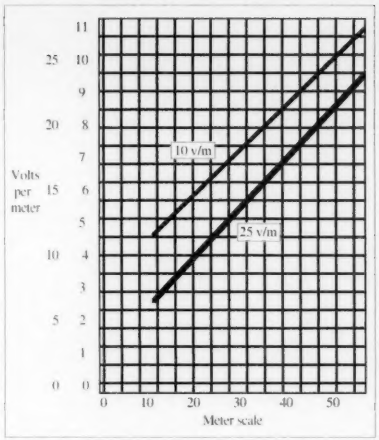

Fig. 2. *For the most accurate readings, use these calibration graphs or calibrate the meter face.*

(measured from tip to tip of the center conductor) works well on both 10 and 6 meters. It is self-supporting—I mounted the two additional trimmer potentiometers in the front of the box with access holes near the meter.

Measurements vs. charts

Actual measurements indicate that the indoor antennas at W6YBT comply with the new emission standards. Who knows what the proposed new charts may indicate?

The hula hoop we built cost roughly $85.00; your costs may vary. I am indebted to W6WB and KN6TN for their assistance in calibrating the system. 73

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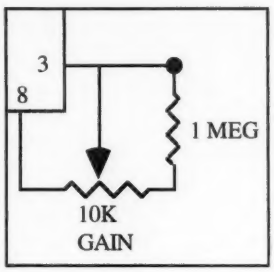
UPDATES

Digi-Sniffer correction

In the February 1997 issue on page 26 of "Build the Turbo Digi-Sniffer," the 10k resistor to the right of pin 8 should be fixed (not variable), with a wiper coming off of pin 3 like so:



Packet scene

In "Reviewing the Packet Scene," on page 40 of the May issue, author Roger J. Cooke's correct callsign should be G3LDI.

TOC

The May Table of Contents erroneously credits "Build the Bioelectrifier" (page 13), the reprint of last year's immensely popular article, to W6WTU. The correct author is, of course, WA8YKN.

No easy out

We received this note from Dave Miller NZ9E, moderator of our "Ham to Ham" column:

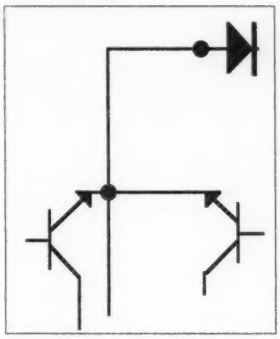
"Please note that the contribution in April 1997's 'Ham to Ham' titled 'Easy in & easy out,' having to do with home-brewing your own thumbscrews for easier installation and removal of a ham mobile transceiver, was credited to Mark Marholin KE6JJR, but was actually sent in by Phil Salas AD5X, 1517 Creekside Drive, Richardson TX 75081. I apologize for this error."

Pin Markings for the Multiplexer

In the May issue, in "Build an Audio Multiplexer," the U3 unmarked pin connected to U2 (pin 4) is #1. As for C8, the A+ side is positive. In the parts list, C5 should be 0.1 µF and C6 should be 33 pF.

TV/VCR Tuners Part 2 correction

In the May issue on page 37, Fig. 3 was missing a connection between two transistors. It should look like this:



Also, on page 38, Fig. 4 has a resistor off of pin 3 that is missing its value, 150Ω. Finally, the tuner pinout next to AGC in Fig. 1 should read VT, not YT. 73

NEVER SAY DIE

Continued from page 5

fix mine, and they're quite different. Hers are right in line with the green-world food list in Margaret's book, while mine are 95% in agreement with the red-world food list. Yes, I'll be eliminating that 5%, which could be causing me some minor chronic health problems.

The book is ISBN 0-964-3261-4-0, 142 pages, 1996, published by Veritas, Sedona AZ. Since it's not in many book stores your best bet is to get a copy from Margaret. Send $12 to Margaret Chaney, Box 726363, Berkley MI 48072. It could change your life. It will certainly change your perspective on life. How come all life is organized on male-female and red-green divisions?

The choice is up to you. You can keep on ignorantly doing what you've been doing to yourself, or you can read this book and give your body the break it has so desperately needed and has been trying to tell you about. It might even make you more fun to talk with on the air.

Flight 800

With the continuing mystery about the downing of 800, I would be shirking my duty to you as a known rag chewer if I didn't pass along a rumor I heard. It's a good solid rumor, considering the recent exposé TV shows substantiating the missile theory.

My understanding is that Flight 800 was delayed in departure and that at the time it crashed it was in the time slot of an El Al flight, leading to the probability that this could have been an Arab-inspired shooting down of the flight. Perhaps we have the Palestinians to thank? Or Syria, Libya, Iran or Iraq? Hmm, where was Arafat when the plane went down?

Well, you needed something better to talk about than the weather. Say, the weather has been changing, hasn't it? Maybe Ted Dames, the famed remote viewer who holds us semi-entranced on the Art Bell show, is right about the world coming to an end in two years. Drat, and that'll be before the sun spots really bloom for us again. Sigh, and I was so looking forward to being able to work 20m all night again.

Ear Plugs

Yes, Your Dishonor, I plead guilty to bashing the League. And to bashing our beloved federal government, both en masse and in each of its initialed and rightfully feared bureaus. And to bashing our music industry, our media, our legal (snicker) system, our health care (har-de-har) system, our educational (sigh) system, and so on.

Yes, I should open a cold beer, sit down and watch a ball game on TV, and stop reading subversive books. I should sink back into the hypnotized obedience shared by around 99% of the public and stop questioning authority.

Nothing can be done about the corruption which dominates our

Continued on page 70

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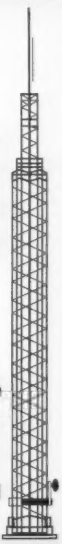

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Silk-screening a microwave antenna

The next antenna area to explore, and where I put most of my efforts, is in the construction of antennas for the frequencies of 1296 and above. In this region you can carry the antenna or antenna feed in your lunch sack—that is, with the exception of the microwave dish reflector. As you know, when the frequency is increased further and further, an antenna's size is reduced by the same proportions. The advantage is that GHz-type antennas are very small and can be built on top of a magazine cover.

The dish mechanism that the feed illuminates with RF is the device that provides the actual gain by focusing the RF radiated power into a beam, much like the reflector of a flashlight. The bulb by itself is bright, certainly, but then the reflector (dish) focuses the bulb's energy into a high intensity beam instead of scattering it in all directions. Very high gain in the 35-dB range can be achieved with relatively simple dish antenna sizes of three feet or so.

For instance, a dish, or more commonly, parabolic antenna, can be fed at many different frequencies. A large coffee can will function at 1296 MHz, while a smaller-diameter one will function at 2304 MHz. As frequency increases, so do the dimensions needed for a feed structure. Of course, as we go higher and higher, feeds get smaller and the need for more exacting measurements in the construction of these devices needs to be addressed. Using a coffee-can type of antenna feed is sometimes passed over in favor of newer designs, but the coffee can still will do a very good job.

You feed a coffee can by means of a probe connected to a type "N" coax connector spaced 1/4 wavelength from the rear of the can. This will be the transmitting probe. A second probe can be attached 90 degrees offset from the first probe and used for receiving. The coupling between probes so offset is minimum (with a typical coupling loss of 30 dB between them), providing very good isolation. This type of design was very popular in the early days of microwave, and in some cases is still used today. One name given to this type of feed is a Polaplexer, a sort of twist on the names polarization and duplexing or mixing signals together.

Today, much more efficient designs for the same frequency regions can be simply constructed by home fabrication techniques. The best of all worlds came together when I saw, for the first time, a triband feed constructed on a relatively inexpensive substrate glass epoxy FR-4 printed circuit board.

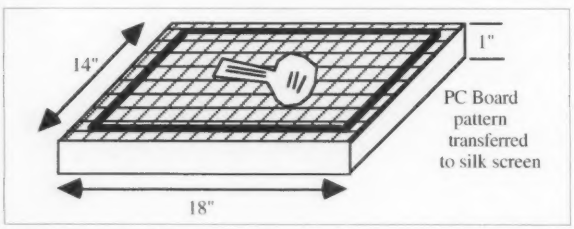

Fig. 1. A typical silk-screen showing a home-made wooden frame made from 1- by 2-inch pine. Black line is window screen tubing to hold fine-mesh silk-screen material in cut in bottom of wood. Make screen taut like a GI bunk. Screen material is actually nylon with 306 mesh threads per inch. The original process used silk, hence the name.

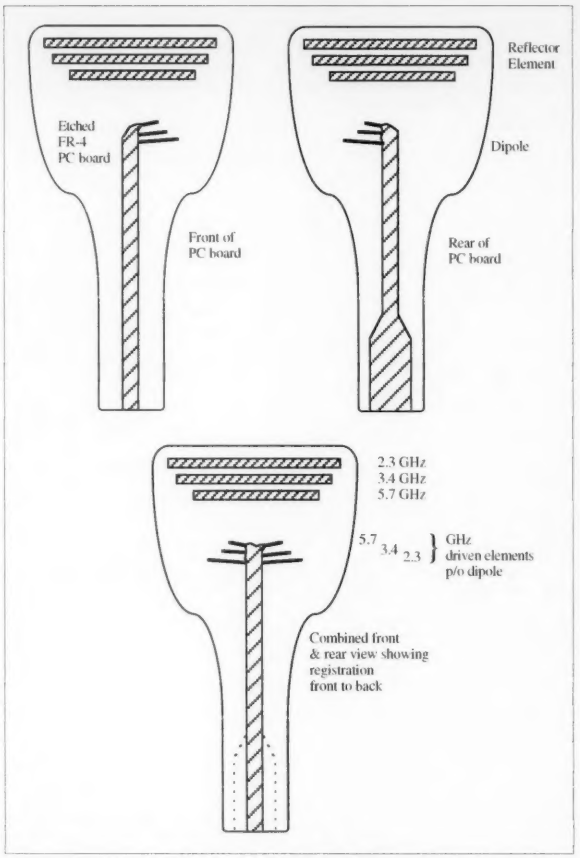

Fig. 2. Diagram of WA3RMX triband feed showing the rear and front sides of the PC board. Double-sided PC board is required, with an exact registration between both sides. Solder rear side wide trace to shell of RF connector, narrow trace to center pin. Scale artwork is available in The ARRL UHF/Microwave Projects Manual.

This three-band feed design with artwork for the PC board layout was published in both *The ARRL UHF/Microwave Projects Manual* and in the August 1990 issue of *QST*. I came across it while reviewing an article I authored with Kerry N6IZW in the same projects manual.

The antenna was designed by Tom Hill WA3RMX. Basically, this simple feed is quite clever in that a single piece of double-sided .062 copperclad circuit board (FR-4) contains a small, very efficient, low-power, three-band parabolic dish feed. The frequencies that this feed covers are the 2304 MHz, 3456 MHz and 5760 MHz amateur bands.

This feed had to be tried out by our microwave group to assist an ambitious project that called for the construction of a new microwave frequency band transceiver converter in time for testing at our monthly club meetings. Our intent was to construct as many different frequency converters as possible for communications on different amateur bands.

We had many rigs constructed on the 10-GHz amateur band, so we wanted to promote interest in the 1296 to 5760 MHz bands as well. I covered my 1296-MHz rig's construction in a recent past column and showed its versatile conversion scheme using the 1152-MHz local oscillator both for conversion and as a harmonic generator for markers at our higher frequency bands. The rigs constructed for 2304, 3456 and 5760 MHz had one common fault, and that was what to use for the antenna feed. This PC board design by Tom Hill could not have presented itself at a better time.

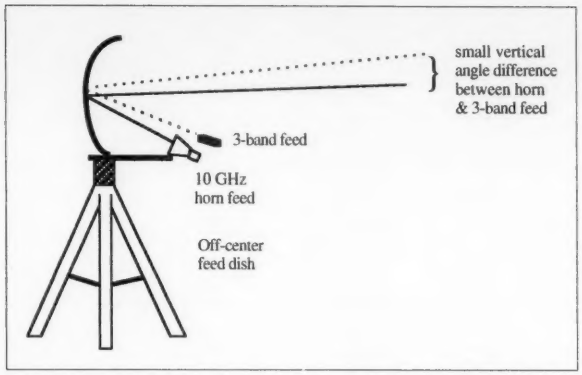

Fig. 3. *Drawing of triband feed mounted on my off-center-feed dish with 10-GHz horn feed attached. The WA3RMX triband feed is held in place with a length of RG-141 semi-rigid solid copper jacket microwave coax. The RG-141 coax is bent and formed to position the 3-band feed just above the 10-GHz horn at the focus point. Slight vertical realignment is necessary to align either the horn or the tri-band feed. No repositioning is required in horizontal position.*

The beauty of the PC board feed was that it could be employed on our standard dishes at the same time as our 10-GHz feed, and be positioned just above it—sort of out of the standard pattern. This arrangement allowed rapid frequency hopping with converters to operate on different bands. Once the dish antenna was properly pointed on one frequency, only minor changes in pointing angle needed to be addressed as we only had to change out the electronic packages (converters), keeping the dish on the same exact pointing angle to the distant station.

This made multiband operation very easy and quite enjoyable. We left all the 10-GHz equipment hot and connected, and just tilted the vertical angle to allow the 3-band feed (which was slightly higher than the 10-GHz one) to be properly aimed at the distant station. Because the 3-band feed was higher, we had to lower the front axis of the dish point angle for this feed, to lower than what was used for 10 GHz. It's just like watching a pool ball on a pool table bounce off the cushion. If the starting angle is higher than the first attempt, so will the course of the second ball be higher. It's the same with microwave dish antennas and pointing angles. See **Fig. 3** for a graphic depiction of this pointing angle difference between the 10-GHz feed and the three-band feed.

As mentioned, construction details for this feed were graciously provided in *The ARRL UHF/Microwave Projects Manual*. I wanted to use the silk-screen process because I was familiar with it and have material on hand to reproduce PC boards to near photo tolerances. I had tried the technique on a 10-GHz amplifier with success and wanted to see how my double-sided PC board construction skills would hold up, since most of my construction to date had been with single-sided PC board projects.

Silk-screening is relatively easy, but very fine lines stand the chance of losing detail since the mesh or screen has threads of .001-inch diameter. The artwork adheres to the screen just after its development in hydrogen peroxide, where it resembles a soft, Jello™-like substance on a Mylar™ backing. After development and washing in a stream of aerated, bubbling, mildly warm water, the pattern to be transferred to the screen is made clear while still in a somewhat jellyish liquefied state. It is this soft material that embeds itself into the screen, to make a tough surface once dried, allowing ink (resist) to be squiggled through the patterns of whatever you are making. The ink dries and the etching of remaining unprotected copper begins.

The finished process is the completed PC board. Of course, I forgot to tell you that you have to repeat the process on each side of the PC board to make a mirror image in the exact, or nearly exact, position (registration) from front to back. You will know you are okay if, when you hold the etched PC board up to the light, you see through the PC board and observe a symmetrical pattern (registration) between the front and rear sides.

The first step in making any artwork, be it for the photographic or silk-screen process, is to obtain a high-quality negative or positive of the original artwork to exact dimensions. The camera that I use is over 90 years old and weighs some 60 pounds. It's an antique but still functions well. The camera uses a slide plate film holder to which a sheet of film up to eight by 10 inches can be held in position, or a smaller piece of film can be taped in place. To focus this large-format camera, a frosted piece of glass in a holder is inserted in the back of the camera, and the lens opened.

You can see the object on the frosted glass and adjust magnification or reduction and focus manually. Final verification as to exact size is made by observing an IC socket, holding up a new IC, and comparing its pins to the film plane view. Using the IC like a micrometer for vernier, observe the exact placement of the first pin, and carefully check the last pin in a row for any error. This is a simple method for exact size requirements in your manual setup. For an object such as the three-band antenna, you have to rely on a vernier caliper to measure exact distances and allow a "fudge" factor for the silk-screen process.

I used a slight fudge factor, increasing dimensions about .003 to .005 inch to account for

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processing with silk-screen reproduction of transferring etch resist inks to copper PC board. The screen material I used has about 300 threads to the inch (making them about .001 inch in diameter), so I doubled the thread dimensions as a fudge factor, giving some allowances for the fine antenna elements. I further doubled this screen factor to account for some undercutting of the PC board fine traces during board etching. See **Fig. 2** for an outline of the antenna pattern. For exact dimensions, get a copy of *The ARRL UHF/Microwave Projects Manual* and see the original artwork.

Why go through all this hassle to make a PC board using the silk-screen process? Well, there are several reasons, number one being that it is inexpensive and can be done at home easily. True, it does require some photographic capabilities, but that is true in any board process. The main reason is that once a screen is imprinted with a pattern of your current PC board project, you can squeegee inks onto a PC board (one side) as fast as you can count to five. Then, to make a pattern on a second side, you wait until the ink is dry, set up registration marks to verify that both sides of the board are in alignment, and screen off the second side. Both sides should be in alignment within 15 to 20 thousandths of an inch to function well.

I would not set up an individual amateur to do silk-screening to make one PC board. It is more suited for club projects where many boards are needed. To serve the club needs and be able to construct quite a few boards at one time for a current project is just one way to keep a group interested in new and interesting projects to aid their operation and goals.

Silk-screening is a great method for these club projects as it is very inexpensive. Materials for silk-screening can be stored for very long times and are not date-dependent. The film used to transfer an image onto a screen costs $25 for a lifetime supply, and can be used in normal indoor lighting. Just do not expose it to direct sunlight as it is very sensitive to UV light.

dB return loss	SWR	% power reflected
40	1.02:1	0.01
30	1.07:1	0.12
20	1.20:1	1.00
15	1.45:1	3.00

***Table 1**. Return loss vs. SWR and reflected power.*

"It's just like watching a pool ball bounce off the cushion."

Normal exposure is sunlight contact printing for one minute. This film is developed in hydrogen peroxide and water (50¢ a pint in any drug or grocery store). The resist ink costs about $10 a quart and will last several years. The process is such that the transfer film is water soluble, while the inks are petroleum-based, requiring petroleum solvent (like paint thinner).

Now that I have gone through the entire process to construct a PC board antenna that can fit in my pocket, the project is just starting to get interesting. The next step was to test and determine how well we did. Will the antenna feed perform at all three frequencies or did we just spend a lot of time constructing something not usable? Well, whether you call us lucky or technically competent, I don't know—but testing showed a very usable antenna feed.

Kerry N6IZW was able to run a return loss test over the frequency span of 600 MHz to 6,000 MHz in one continuous swept test. See **Fig. 4** for the frequency sweep chart, showing very good results at our three frequencies of interest.

By the way, a good return loss measurement is just the same as saying a good SWR is present at a point of interest. Look at return loss as saying at a specific frequency the (device) is absorbing nearly all RF power and is returning very little RF power back to the source. While return loss is expressed as a dB value, SWR is expressed as a ratio between forward and reflected power.

The relationship between a low return loss dB value and a poor SWR is identical. See **Table 1** for a few relationships between the measurements.

The performance obtained from the triband feed was very good and showed a raw return loss of 23 dB at 2304 MHz, 30 dB at 3456 MHz, and 17 dB at 5760 MHz. The exact minimum return loss was in all cases a little high in frequency, although quite usable as is. While we missed the mark (high) by a small amount, this proved to be a very lucky break for us. The original antenna feed was tested "raw"—that is, without a protective coat of polyethylene or similar material to stop the copper from being affected by the wind, rain and such. When the finished antenna was sprayed with a protective coat of resin, the total effect was a dielectric loading of the elements and lowering of the resonant frequency a few percent, making all frequencies better placed on the slope of the return loss curve. Was this a case of three wrongs make a right? I'll never tell, but just call me lucky from now on.

In actual use suspended by the rigid RG-141 solid coax, my antenna proved to function very well. Changing to a different transverter band only required undoing the main DC power cable and the antenna coax as well as the IF coax, and connecting them back to the new frequency unit for minimum effort to change bands rapidly for any QSO party. 73

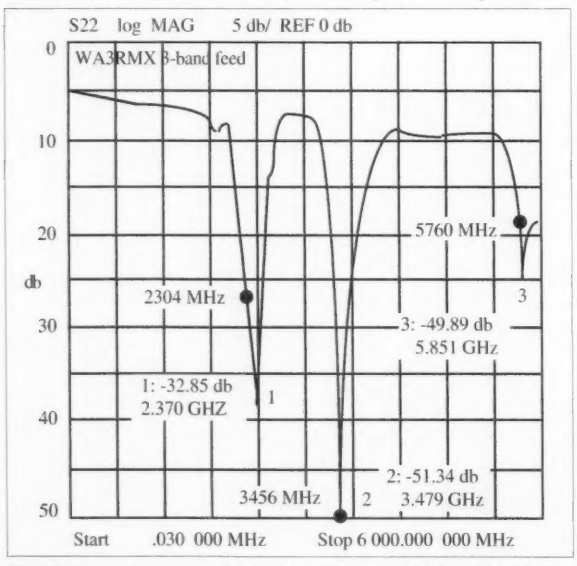

***Fig. 4**. Return loss curve obtained on silk-screened 3-band feed before dielectric loading.*

On the Go

Mobile, Portable and Emergency Operation

Steve Nowak KE8YN/5
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High fashion for hams

What does the well-dressed amateur radio operator wear when called upon to provide communications in an emergency situation? While the handie-talkie on the belt and the callsign name tag are required, there are many other important accessories that should be on his or her list. The following suggestions are not intended to be all-inclusive, but should prove to be a good starting point for when you get that phone call to report to the disaster services office, Red Cross or other agency.

Radio gear

• The radio itself—don't laugh! It has happened. The old HT may come in handy as a spare, so pack it, too.

• Antennas—if you're taking a handie-talkie, you may want to include an extra rubber duck, a quarter or five-eighths wave telescoping antenna and a J-pole which can be rolled up, such as those made from 300 ohm twinlead. If you're taking a mobile rig, a magnetic mount antenna is essential, especially if you end up in a car not your own. Either a J-pole or a mag mount is extremely helpful if you end up inside a building. The J-pole can be thumbtacked to a wall or taped to a window. A mag mount can be set on top of a metal filing cabinet, which will provide an acceptable ground plane. Also, don't forget connector adapters. An antenna with a PL-259 won't work with a BNC-equipped radio without the adapter. If you have an extra length of cable with barrel connectors at both ends, you improve your chance of finding a good antenna location and a good operating position significantly.

• External microphone—you may have to set the radio away from easy access, so an external microphone is helpful. Also, if you are in the field, this allows you to keep the handie-talkie on your belt and position the microphone on your collar.

• Headphones or earplug—you may be surprised at the noise levels you may encounter, so an earplug is the least you should bring. Personally I like the dual headphones with a boom microphone. If the noise level is high, I use both earpieces. If it is quieter, I can slide one side off so I can hear nearby activity.

• Power—sure, you've got a battery pack and a charger, but how are you going to recharge it if there is no electrical power in the area? This is especially true if you'll be doing damage assessment and walking through the damaged area. Bring your NiCd batteries and charger, but also plan for the worst. A cigarette lighter adapter cable is always handy, as is a charger which can be used in a car. One of the least glamorous and most important accessories you can buy is a battery holder which accepts alkaline batteries. Most take AA, so make sure you have a ready supply of those, as well. If you're operating a high-frequency rig, make sure you bring along not only the power supply but also a heavy duty, and *very long* extension cord. AC power may be in one direction and your antenna lead in the other, especially if you are in a location which forces you to use a generator.

• Cases—some neoprene cases provide excellent shock protection. Some hams like to use a photographer's vest which has a lot of pockets and keeps everything handy.

Personal

While we often do pretty well with the radio gear, here is an area where we sometimes fall short. This is because we assume we'll be out for a day and be back home by night. Sometimes that just doesn't work out. Whatever time you estimate you'll be out, triple it when planning for these items.

• Medication—bring along any prescription medicines, as well as a small bottle of aspirin. If you are working a cold-weather situation, throat lozenges might be helpful. If you're going to be in the heat, don't forget the sunblock. And remember eyeglasses, contact lens supplies, etc.

• Clothing—not a suitcase full, but a few key items. Once again, examine the situation you'll be placed in. If you're at the disaster site, will you need to add a raincoat? Small ponchos are available for a few dollars which fold up into a package little larger than a handkerchief. Hats are essential for rain, cold and sunlight (especially if you're thin on top!). Dress for the weather you are experiencing and throw in a few extras for the weather you might face later. A change of clothes can be essential, especially if they get wet. Shoes and socks are often the first to get soaked. Finally, remember your mother's advice and include some clean underwear.

"Whatever time you estimate you'll be out, triple it and plan for that."

• Toiletries—I like to carry a plastic bag with a disposable razor, sample-size shampoo, shaving cream and deodorant. I once spent four days at a hospital during a blizzard, and those were among the items I missed most.

Miscellaneous

• Identification—if you have been issued identification by a government agency, make sure you have it with you. Also, driver's license, hospitalization card and a credit card. Even though we are no longer required to have our ham license on our person, it is recommended that you carry that as well. Some agencies, such as the Red Cross, use window signs which identify a vehicle as being used by volunteer aid workers. This is useful because many victims of storms or other disasters are concerned about looters. An unmarked vehicle driving by slowly can be very upsetting to someone who has just been through a painful experience.

• Paper, pens, etc.—even if you are being sent to a shelter set up at a school, don't expect to find paper and pencils readily available. A small notebook is handy in the field, while a lined tablet on a clipboard works well in a fixed location. As they say, the smallest scrap of paper is greater than the greatest mind. I like to have a few ball points as well as a permanent felt-tip marker or two. The markers sometimes come in handy on duct tape for making signs, or marking equipment.

• Plastic bags—I like to carry half a dozen sandwich-sized zip-seal type bags tucked into a couple of the larger ones. They're great for keeping things dry, including notebook, spare batteries, etc. I'll also use the bags to hold some of my other supplies, so they do double duty.

• Flashlight—a small flashlight can be a lifesaver. You may not need it, but if you don't it isn't that heavy.

• The Little Stuff—electrical tape, small tool kit, and of course duct tape.

Naturally, each person will have slightly different needs, but this is a good starting point. Most of this should fit pretty easily into a canvas gym bag, and with the exception of the radio and power supply, you can keep such a bag packed and ready to go. I try to check my batteries, the pens, etc. twice a year—I check them when I change my smoke alarm batteries—the same days we switch to or from daylight savings time. This bag of supplies is kind of like a fire extinguisher: You may never need it, but it's nice to know it's available.

Don't forget to send your ideas and experiences, either to the address at the top of the column or via E-mail to [74640.1442@compuserve.com]. 73

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister W5ACM
14714 Knights Way Drive
Houston TX 77083

New Russian in the sky

On March 4th at 0200 UTC a START-1 rocket was launched from the Svobodny cosmodrome in eastern Russia. The payload was a Zeya military satellite, with a few additions. The satellite weighs 87 kg, 14 kg of which is RS-16 (Radio Sport), the newest hamsat in the sky.

Although rumors of the imminent launch of RS-16 have been circulating for a number of months, information has been sketchy. With each bit of new data come more questions. When the new satellite achieved orbit, RS-16 went from conjecture and vaporware to hamsat status. Information began to surface on the Internet, but the pursuit of knowledge continues. What is a START-1 rocket? What and where is the Svobodny cosmodrome? What is a Zeya satellite? What is RS-16 good for? Who can use it, and how?

The rocket

The START-1 rocket is reported to be a modified SS-25 intercontinental ballistic missile (ICBM). In Russia, the SS-25 or "Sickle" is called the *Topol* (Russian for poplar tree). It was designed as a replacement for the unsuccessful mobile SS-16 ICBM. The SS-25 was developed by the Moscow Institute for Thermotechnology (MIT). Several tests were made in the early 1980s and the Strategic Rocket Forces (RVSN) of the Soviet Union accepted the SS-25 for official service in December 1988.

The Topol/SS-25 is a three-stage solid-fueled missile standing just over 60 feet without a warhead. It was designed to carry a single 550 kiloton nuclear warhead. Approximately 70 percent of all Topols for military service are deployed on large seven-axle mobile launchers. The rest are housed in silos.

In 1991 the USSR and the United States signed the START-1 agreement (Strategic Arms Reduction Talks) to reduce nuclear arsenals on both sides by 25 percent. Two years later after the breakup of the USSR, START-2 was signed. This document called for the elimination of almost 75 percent of the nuclear warheads and all the multiple-warhead, land-based missiles in the US and the former Soviet republics. Rather than destroy hundreds of SS-25 missiles, a program was begun to use them as launch vehicles for small satellites. Modifications included the addition of a fourth stage engine to carry the payload to orbit.

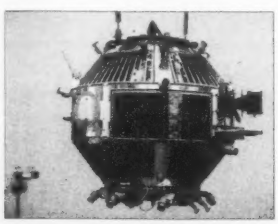

***Photo A**. The Zeya/RS-16 satellite rises from the ashes of the cold war.*

Svobodny

While the START-1 rocket has been flown before, the Svobodny cosmodrome is new. The launch of Zeya/RS-16 was the first from this new cosmodrome (128 deg. East, 51 deg. North) located in the Amur region about 100 km north of the Chinese border. Russia's primary heavy-launch space facility at Baikonur is in Kazakhstan. While the Russian Space Agency has a 20-year leasing agreement with Kazakhstan, it was considered prudent to select a site within the borders of Russia for an additional site. Svobodny was picked in late 1993 since it had various assets of the previous missile division in place which were transferred to the Space Test and Control Center.

Russia's other domestic space center is in Plesetsk. This site is farther north and is not equipped for heavy launch vehicles. The latitude difference is very important. A booster launched from Svobodny can carry 20-25 percent more payload weight to orbit than the same booster launched from Plesetsk.

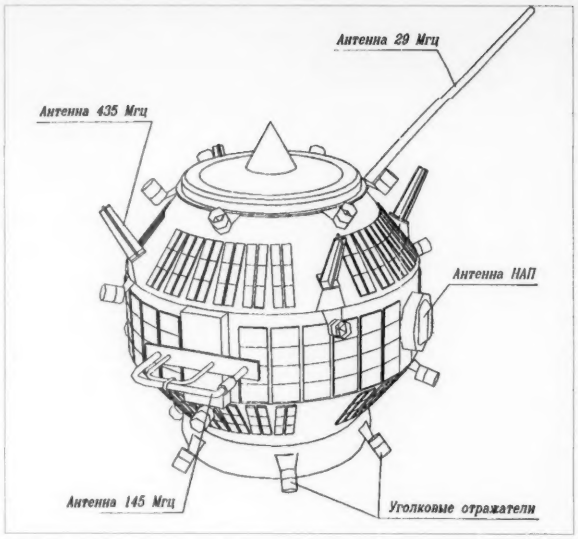

***Fig. 1**. Pictorial view of Zeya/RS-16 showing antenna locations (UA3CR & AMSAT-R).*

The Svobodny cosmodrome incorporates numerous facilities for launch and support operations. The launch sites include silos for Rokot and Start boosters in addition to large Angara vehicle pads that are currently under construction. Most of the complex is located on the north side of the city of Svobodny-18 except the helicopter landing area just south of the city near the Zeya River. Buildings for oxygen, nitrogen and hydrogen generation are part of the system, in addition to radio facilities, industrial operations, purification units and rocket fuel storage. A Rokot launch vehicle flight is scheduled for later this year. Support for the Angara launch vehicle will occur after the year 2000.

Zeya/RS-16

It has been reported that RS-16 is an integral part of the Zeya satellite. Previous RS spacecraft have been separate satellites or self-contained electronic units attached to another satellite deriving their power from the host spacecraft.

Zeya/RS-16 is primarily a navigation satellite with the addition of amateur radio devices. At 87 kg it is relatively small, but carries both a GPS (Global Positioning System) and GLONASS receiver system. On the outside of the craft, 20 laser reflectors provide a means for accurate ground-based optical tracking.

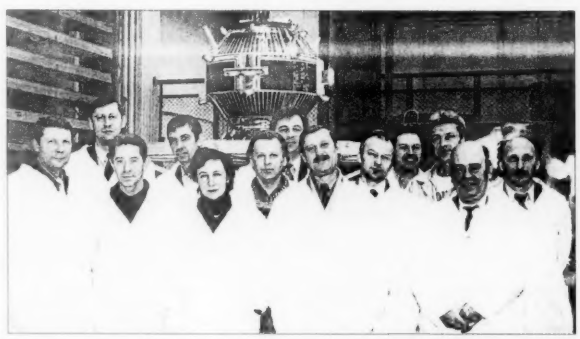

***Photo B**. Zeya/RS-16 and the construction team at the Svobodny cosmodrome. Project leader Alex Papkov RA3XBU is on the right in the front row (photo from AMSAT-R).*

Uplink Passband	145.915 – 145.948 MHz
Downlink Passband	29.415 – 29.448 MHz
10m Beacons	29.408 & 29.451 MHz
70cm Beacons	435.504 & 435.548 MHz

***Table 1**. Radio configuration of RS-16.*

The satellite's orbit is only 470 km up with an inclination of 97 degrees. This low polar orbit provides about four orbits per day for most hamsat chasers. The orbit is sun-synchronous with passes occurring around noon and midnight local time. These passes last between six and 14 minutes each, depending on the maximum elevation with respect to the observer.

Working RS-16

Our newest hamsat is a Mode "A" satellite with a few additions. Mode "A" refers to the combination of a 2m uplink receiver paired with a 10m downlink transmitter. The satellite is equipped with one 10m antenna, one or two antennas on 2m and four for 70cm. **Table 1** shows the uplink/downlink passband and beacon frequencies.

The 10m output power is switchable between 1.2 and 4.0 watts. The 70cm beacons run at 1.6 watts out. **Table 2** shows two typical samples of CW telemetry received on the 435.504 MHz CW beacon. The parameter definition column is incomplete due to a lack of information from the satellite builders. More details will filter out of Russia in the months to come.

Shortly after launch, the 10m beacon on 29.408 MHz was active, sending data back to ground controllers in Russia and monitoring stations around the world. This beacon was then shut off, while the 435.504 MHz beacon was activated. The beacon frequencies on 10m and 70cm are easy to receive. The signals are quite strong. A portable shortwave receiver with SSB (single-sideband) or CW capability can receive RS-16 with only a built-in whip antenna. The 70cm beacon is strong enough to open the squelch on a FM handie-talkie with only a "duck" antenna on a good pass. To get good copy on the 70cm CW telemetry, though, a receive converter or multimode 70cm rig is needed. There was some early speculation about the possibility of a transponder output between the two 70cm beacons, but sources in Russia have stated that the craft does not have that capability.

When the transponder is activated for general use, operation should be as easy as the popular RS-10 satellite, only with better downlink signals. RS-16 promises to be an exciting satellite. It's in orbit and it works. Old ICBMs are good for something... more hamsats!

Field Day 1997

Field Day is always scheduled for the fourth weekend in June. This year that occurs on the 28th and 29th. We have one fewer high altitude satellite (A-O-13), but a few new low-earth-orbit satellites for extra points in the American Radio Relay League competition, or for the AMSAT (Radio Amateur Satellite Corporation) activity. The AMSAT rules last year worked well and will show little if any change for 1997. Check the AMSAT Web page at the URL (Universal Resource Locator) [http://www. amsat.org] for details. The Field Day information is down a few levels under the "activities/amsatfd" subdirectories. The rules will also be published in the *AMSAT Journal*, or can be obtained for a self-addressed stamped envelope from me, W5ACM. 73

CW Data Day Pass	CW Data Night Pass	Parameter Definition
RS16	RS16	Satellite Identification
P167	P158	PSU Voltage (16V nominal)
O220	O0	Solar Panel Voltage
N46	N0	Solar Panel Current
M0	M0	
L0	L0	
K7	K7	
J5	J5	
I7	I7	
H49	H49	
G0	G0	
F164	F155	
E8	E9	Inside Temp. 1 in degrees C
D5	D5	Inside Temp. 2 in degrees C
C8	C9	Inside Temp. 3 in degrees C
B8	B9	Inside Temp. 4 in degrees C
A6	A6	Inside Temp. 5 in degrees C
RS16	RS16	Satellite Identification

***Table 2**. Partial description of 70cm telemetry values received from RS-16 on March 23, 1997, for two typical day and night passes.*

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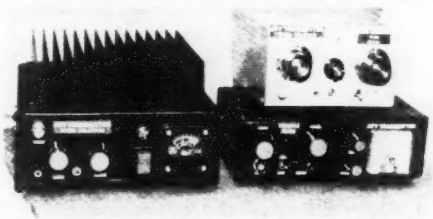

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Color quagmire

I've been re-reading some of my old color TV reference books, and I feel I was not sufficiently accurate in last month's treatise regarding the encoding of the color signal. Although the chroma portion of the signal is, indeed, encoded on the color subcarrier, I'm afraid my description of exactly how it's done was a bit off the deep end in spots. To fully understand it, you need to delve into quadrature modulation, I and Q signals, and some other pretty hairy stuff. For our purposes, though, just consider that the color subcarrier is a complex signal whose positive and negative peaks contain separate color information, and whose phase describes the color value, while the amplitudes of the peaks describe the saturation (strength) of the color. And oh, yes, it's a suppressed-carrier signal, just like we use on sideband radios.

Touchy

The upshot is that the color subcarrier is one touchy signal, especially where time is concerned. Just a few fractions of a microsecond of time jitter, and it's useless. In normal broadcast service, this sensitivity to timing errors wasn't important, as the timing of a signal doesn't change just because you send it over the air. At least, not with line-of-sight VHF/UHF signals.

Recording it was another matter altogether. No mechanical system can remain stable enough to avoid sub-microsecond timing errors! In fact, typical errors for a moving device are many orders of magnitude greater. But before we get into the fine details of recording color, let's look at video recording in general: how it happened, what it took to make it work, and what led to the development of that $250 VCR on your shelf.

A lotta lotta

By the time all-electronic television was developed, audio recording had been around for a long time. Starting with the good ol' needle-in-a-groove approach of the phonograph record, and progressing to practical magnetic recording, there'd been lots of development in sound recording. Sound wasn't really that hard to record. All you needed was a fairly stably-moving medium and a way to impress a varying signal on it. The key to the relative ease of recording sound was that the amount of information required was not high. For decent, understandable speech, 3 kHz would do. For good music fidelity, no more than about 20 kHz would ever be required, since most human ears can't hear anything above that anyway. Of course, to provide the true high fidelity of today's sound media, many years of research were needed, as frequency response is only a small part of the overall requirements. And research into better sound is still going on at a furious pace. Still, if you could capture 3 kHz or so on any medium, you could record usable sound.

The requirements for storing television signals were much, much greater. In TV, there's a whole lotta signal going on! A monochrome signal conforming to the American format of 525 lines and 30 frames per second required well over 3 MHz, or 1,000 times the bandwidth of a low-fi speech signal. Even long before color was part of the equation, people were searching for ways to record TV signals. The broadcast industry badly needed a way to store programs for editing and later transmission.

The first successful approach to storing television images didn't record the video signal at all! Called the "kinescope," this machine simply put the image from a picture tube right onto regular movie film. It worked decently, but because the scanning lines of the original picture, as captured on film, didn't precisely match up with the scanning lines of the camera later used to transmit the image from the film, moiré patterns were a real problem. Also, the film had to be developed before the image could be used. Nonetheless, broadcasters made wide use of the kinescope, simply because there wasn't anything else available. Many great programs, such as the early *Honeymooners* and *I Love Lucy* shows, survive today only because of the old kinescope recordings.

The hunt was on for a better way to preserve and manipulate television images.

"I sure wouldn't have wanted my fingers anywhere near those reels when they got up to speed!"

Crank 'er up

Well, if you needed more bandwidth, you just increased the tape speed of a normal tape recorder until you could cram it all on tape, right? Believe it or not, people built such machines, with linear tape speeds of hundreds of inches per second. These things had huge reels of tape, and I sure wouldn't have wanted my fingers anywhere near those reels when they got up to speed! Did they work? Well, kind of, but it wasn't as simple as just running the tape fast, though. No magnetic head can be designed to have a frequency response from near DC to many MHz, because tape heads are inductors (after all, they're just coils of wire wrapped around a doughnut-shaped core with a gap in it), and inductors resonate. Also, if you make the gap small enough to capture the high frequencies without their blurring together, the head will have almost no low-frequency capability. Still, semi-successful machines were built by splitting the video signal into several bands of frequencies and recording them in parallel on one tape, with head gaps optimized for each band. The BBC actually used such a machine on the air.

A geared-up analog tape recorder had tremendous limitations, though. The obvious one, of course, was how much tape it took to record a useful amount of programming. Even more serious limitations, though, revolved around technical issues. For instance, the splitting and recombining of the video signal resulted in all kinds of phase shift problems, especially since the slightly irregular motion of the tape over the heads caused timing errors that varied from track to track. The result was a wobbly, distorted picture, but it was a video signal, and it was a start toward a practical video recorder.

My head is spinning

In 1956, after several years of research and development, Ampex Corporation introduced the first rotating-head video recorder. Called the "quadruplex" VTR, because there were four heads mounted on the rotating wheel, this machine was aimed at the broadcast market, and was designed to its requirements of high precision. For instance, the mechanical timing error could be servo-adjusted to about one microsecond, which was necessary for proper editing. This was no ordinary tape recorder! Employing two-inch high-precision tape, it involved some revolutionary techniques, such as the servo-controlled rotating heads and FM recording, and cost around $100,000! The heads, which only lasted a couple of hundred hours, cost thousands of dollars to replace. And, on top of everything, a well-trained technician was required to operate and maintain the monster. It was a tremendous success, though, and quad VTRs were the broadcast standard until about ten or fifteen years ago. I'd venture a guess that some are still in use, though they've largely been replaced by much cheaper, more modern formats.

Although the quad VTR did not filter down to the home user, its basic principles were adapted for later, simpler machines that didn't require broadcast precision. The most important innovation was

the rotating head concept. There was just no getting around the fact that a high head-to-tape speed was required for the bandwidth of a TV signal. But why move the tape past the heads real fast when you can move the heads themselves? By using a narrow track width, and spinning the heads, it was possible to create a series of tracks next to each other on the tape, effectively utilizing the entire surface area of the medium in a very efficient manner. This permitted the linear tape speed through the machine to be slow (the quads ran at 15 inches per second, and a modern home VCR runs at a fraction of an inch per second). At the same time, the actual head-to-tape speed could be anywhere from, say, 300 to 1,500 ips. Though the rotating head technique introduced all kinds of technical obstacles of its own, it at least solved the bandwidth problem, which had plagued the development of video recording from the very beginning.

In 1960, only four years after the debut of the quadruplex VTR, Sony Corporation introduced the first commercially available helical recorder, which also had rotating heads, but which differed in many significant respects, and cost about 1/50 what a quad machine cost. Although there's much controversy over who actually invented the helical concept, in which the tape is wrapped around a drum in diagonal fashion, producing a slanted recording track, it appears that it, too, came from Ampex. Sony and Toshiba quickly developed it into a viable product, though, while Ampex stayed devoted to making the big broadcast machines.

This new, relatively inexpensive, machine was aimed at the non-broadcast user, and wasn't designed for the tight specs required for broadcasting. It, too, was an instant hit, and refinement of its principles, and conquering of the color problem, eventually led to the modern VCR. Next time, we'll take a look at helical video recording. Until then, 73 de KB1UM.

LETTERS

Continued from page 7

Amateur Radio art on the HF bands whereas additional theory is not. It is a skill that can be mastered by anyone... who is not mentally handicapped..."

The CW requirement was a logical necessity in the eras when it was the only or primary means of radio communication. With CW's actual usage today accounting for only a small fraction of contacts and being arguably the least efficient mode of data throughput, it has been retained as a form of hazing with absolutely no logical supportable argument as to why its retention upholds any of the five principles our service is charged with in Section 97.1 of the FCC rules. In fact, today CW's requirement is in direct conflict with all five of these principles. I will assume Mr. Hanlon slept through his Novice theory class and missed these fundamental reasons for our existence.

These principles include "to advance the radio art, to improve communication and technical skills and to increase the number of trained radio operators and electronic experts." The wrong answers on the Novice test include "to preserve old radio techniques" which unquestionably describes the requirement of CW. There is no mention that testing should be used to preserve the status quo with regard to the numbers using the HF bands, as he suggests, but rather we are charged to increase the number of trained operators and electronic experts. Creating and maintaining community and emergency service relationships (another one of our principles) are much more easily obtained when one first demonstrates modern, fast communications in a form everyone can understand. And if "untrained" people can communicate effectively internationally with the Internet, there is no reason similar goodwill cannot be enhanced (principle #5) with the many other forms of communications at our disposal, rather than hobbling our efforts by filtering out bright potential representatives.

Continued on page 77

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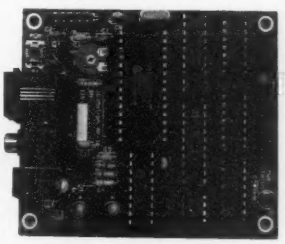

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Michael Bryce WB8VGE
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With Field Day just a few weeks away, I thought this month I would take a look at the different ways we can power our QRP rigs in the field. Perhaps the simple fact that a fully operational HF ham station can be operated from a small NiCd pack is the biggest plus for QRP operation. Of course, not only can we operate our equipment with such small energy sources, but we can make worldwide contacts at the same time.

I've always been a sucker for battery powered stuff. I've got one of the few battery-powered lawn mowers in the county. As a matter of fact, it's the only solar-powered lawn mower I know of in the *state*.

Batteries for portable QRPing

My first fully functional portable QRP station consisted of a Heath HW-8 and a small six-amp-hour lead-acid motorcycle battery coupled to a small homemade solar panel; I could run this station for a week before the battery went south.

Of course, the motorcycle battery was not designed for cycle use (sorry!) and was quickly destroyed. Today, we have a whole slew of energy choices to pick from. Many of us are well aware of rechargeable batteries. We use them all the time in a wide assortment of gadgets. But don't overlook the use of secondary (non-rechargeable) batteries for QRP use. We'll look at those guys some other time.

When we start talking about batteries, we need to know two important design specifications; energy density and energy stored per unit of weight.

Energy density is, in its simplest, how much energy can be stored in a certain amount of space. Different battery chemistries have different energy densities. The idea is to select a battery that has the largest energy density. While this sounds simple, it's really not! Some of the newer hi-tech batteries are so expensive, you can't afford to use them. Others have strange charging demands and require special devices to recharge them.

Energy per weight is also a simple way of stating how much bang can be placed in a certain weight. There's a specialized name for this, but what matters to us is how heavy the battery must be to operate a given load for such and such a time.

There's not enough room to go into all the diversified types of batteries we could use to power our rigs during Field Day. Instead, I'll look at two of the all-time favorites as well as two new types just now coming into the market.

"My first QRP rig ran on a motorcycle battery and homemade solar panel. It could go for a week."

Lead-acid batteries

These guys have been around for eons. They're simple, easy to build and totally recyclable. In a nutshell, the lead-acid battery consists of two slightly different types of lead or lead paste suspended in a weak sulfuric acid solution. Passing an electrical current between the two plates changes their chemistry, while increasing the specific gravity of the acid. Connecting a load between the two plates reverses the process. You can repeat this charging and discharging cycle thousands of times, provided you don't abuse the battery.

On the down side, lead is lead and it's heavy. Then, of course, you have all the acid to contend with. The lead-acid battery does not like cold temperatures and in fact, if the battery is discharged, it will freeze if allowed to get too cold.

Lead-acid batteries also produce hydrogen gas when charging, so you can't use a lead-acid battery in a sealed container.

Some of the problems with the liquid acid electrolyte have been fixed by suspending the acid in a gel. The result is the gelled lead-acid battery, or "gel cell." With the acid thus suspended, you can easily operate the battery at any angle, including upside down. Within reason, you can subject a gelled lead-acid to freezing temperatures without damage. That's one of the reasons for the large 1000-amp-hour-plus gelled lead-acid batteries. You'll find these guys hiding in telecom sites worldwide.

Charging a lead-acid battery

You can use either a constant current or constant voltage charging scheme. A simple 78-series regulator configured as a constant current source is super cheap. Just set the current to whatever the battery is designed to accept. If you choose to use a constant voltage charging source, a lead-acid battery will need to be charged to about 14.1 to 14.5 volts. The final voltage will be set by the battery manufacturer. Always follow their specifications. Some of the newer captive gel lead-acid batteries will be destroyed if the terminal voltage during recharging exceeds 14.1 volts.

You can also use a specialized IC to charge your lead-acid batteries. Several companies such as Maxim and Linear Technologies produce lead-acid battery charger ICs. And of course, I had the popular pulse charger presented here years ago that works super on the gelled lead-acid batteries.

For me, nothing beats running a QRP rig from a lead-acid battery. They're cheap and easy to come by. When they die, they are accepted by anyone who sells lead-acid batteries, including all the major car repair outlets.

With capacity choice ranging from 1 amp hour to 1900 amp hours, I find the 6.5-amp-hour battery to be just about perfect. It has more than enough oomph to run a five-watt rig all day long—and it can easily be recharged with a small 10-watt solar module. The 6.5-amp-hour battery is light enough to tuck into your backpack for those trips that really do go into the field.

NiCds

I guess this battery is the number one rechargeable used in the consumer market. It's no wonder—we've seen the trickle-down effect of all those cordless phones and power tools.

NiCd batteries consist of a mix of nickel and cadmium held apart by a base electrolyte instead of the acid base, such as sulfuric acid, used in the lead-acid batteries. The electrolyte used in a NiCd is usually potassium chloride.

The cadmium inside a NiCd is *extremely* toxic. Depleted NiCds *must* be disposed of correctly. In fact, so many NiCds are living in so many consumer goodies, you can take your deal packs to any local Radio Shack store for disposal. Many other electronic stores are also supporting a battery disposal program, too.

NiCds come in a wide variety of shapes and sizes. Most of us are used to seeing the AAA, AA, C, and D cells. Current capacity ranges from milliamperes to amperes within these sizes. You can also choose the sub C cells and the so-called sub D cells, too. After you reach the D cell, usually the next step is what is known as wet pocket NiCds. For our use, we won't discuss these today. I *can* tell you they are very expensive.

At 1.2 volts nominal, the NiCd will produce a lightly lower terminal voltage when compared to a same number of lead-acid cells. The nominal voltage for a lead-acid cell is 2.0 volts.

Memory effect, or what happened to my charge?

Depending on whose back yard you're talking in, NiCds have a memory or they don't. In case you've been stranded on a island, NiCd memory is simple to understand. Here's how it goes: You charge up the batteries, say, in a cordless phone, and use the phone for one hour each day. Every time you are done with the phone, you plop it back into its handy charger. After a while, the phone will only work about one hour. In effect, the battery has developed a "memory" of being used only one hour and that's all the juice it will give up. Buy a new cordless anything and you'll see in the instructions all about battery memory.

On the other side of the fence sits the guy making the batteries. They say the problem is not with the battery, but how the battery is charged. Improper charging produces the memory effect.

Brainwashing, or dealing with NiCd memory

The best way to eliminate NiCd memory is to simply use the batteries to their fullest before recharging. Allow your cordless phone to beep the low battery warning before returning it to its charger. Some companies have designed special battery cycle circuits that discharge the battery first and then recharge them at a controlled rate. At first, it sounds like a good idea, and it does work. However, it also cycles the battery every time you place it into the cradle of the machine. In effect, to fight the memory, you shorten up the life of the battery pack. So, save your money and just recharge the NiCds when they no longer can run the load.

There's a slew of specialized charge control chips on the market to help prevent memory problems with NiCds. In fact, BAH has some software that will configure their chips to handle just about any type of cell or cell configuration. The next time you are surfing the 'net, check out this site: BAH.

Fast-charging NiCds

Fast-charging NiCds seem to be the "in" thing today. By using one of the controller ICs, it's not that hard to do. However, if you plan on building a NiCd pack and installing it in your new rig, and want to fast charge that pack, think first! Fast charging will cause the battery pack to really get hot. So hot, in fact, that you must add a thermal cutoff to one of the cells. That way if the cell overheats, the cutoff will tell the controller IC to stop or reduce the charging current. Now, I don't know about you, but I would think twice about putting something that hot inside a box holding a VFO of mine!

Building a stick

Since most of the NiCds I've come across are in the standard sizes such as C or D cells, it's easier to build a NiCd stick. I prefer to use sub C cells with metal tabs spot welded to the ends. It's not good to solder directly to a NiCd cell. Buy the tabbed cells instead. The tabs usually need to be trimmed a bit shorter before soldering together.

You'll need some heat-shrink tubing, large enough to slip over the cells. Solder the tabs together on five cells, leaving a plus and negative lead. Join the cells together with a wrap or two of nylon strapping tape. Slide the heat-shrink over the assembly, and, using a heat gun, shrink the tubing. Make a second stick. I generally use a fuse between the two sticks. A small inline fuse holder is ideal.

If you plan on using a fast charger, don't forget to add the necessary thermal cutoff to one of the cells. Usually, I make up two five-cell sticks. There's no reason you can't tape the two sticks together to form one NiCd battery. With the two sticks done, it will give you a nominal 12-volt battery at about three amp-hours, using 3,000 mA sub C cells. If you don't want to mess with all the work, I've seen ready-made NiCd sticks on the surplus market.

Zap those NiCds

When looking for batteries on the surplus market, you sometimes find bargains that seem too good to be true. Most are. Older NiCd cells sometimes develop internal shorts. These are caused by small whiskers shorting out the internal workings of the cell. One way to get rid of these whiskers is to zap them with a high current jolt. This vaporizes the whisker, allowing the battery to be charged. Or so they say.

"I have the only solar-powered lawn mower I know of in Ohio."

I've used a large capacitor, a zillion mF or so, and then discharged the cap across the NiCd. That burst of energy will zap just about any whisker hiding inside a cell. On the down side, most zapping will only give you a few more cycles before the whiskers grow back and the process has to be repeated. Zapping NiCds works best at the cell level. Zapping a complete battery, with many cells inside, usually won't work. And to make matters worse, most of the battery packs are sealed and you can't get to the individual cells. My opinion? Zapping NiCds is a waste of time.

Tidbits

No matter if you use lead-acid or NiCd rechargeable cells, there is a time when the cells will no longer work. Remember, rechargeable means rechargeable, not eternal.

Always keep in the back of your head the amount of energy stored inside a battery. Just a single sub C NiCd has enough capacity to weld tool tips and melt metal. A fuse is always required with any battery pack.

Also, keep in mind the very nature of batteries. They all have rather nasty guts inside. Always dispose of them correctly. And never *ever* throw dead batteries in a fire. They'll explode! 73

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Connectors and splices

Fiber cables can be connected together in various ways, but the connection must be done carefully to avoid light loss from one cable to the next. Splices and fiber optic connectors have to do two things: hold the two fibers firmly together end to end, and align the two cables so as much light as possible goes from one into the other.

Connections can be broken down into three types:

- Pluggable connectors
- Splices where the two fibers remain separate
- Splices where the two fibers are joined into one

There are a number of factors that come into play:

Distance between fibers. If the two fibers are separated from each other, light will escape the joint. Thus those splices where the two fibers actually join into one are best. But when the fibers remain separate, it is usually best that they do not touch, because actual physical contact between them can cause scratches which deflect or even reflect the light. Holding the two fibers firmly, keeping them aligned, yet not letting them touch obviously requires care. In some connectors, a liquid with a similar index of refraction is placed into the gap between the two fibers to provide a better light match.

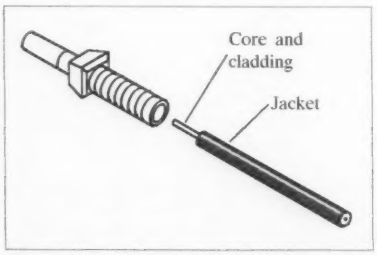

Fig. 1. One type of plug for plastic fiber.

Side-to-side alignment. The two fibers must be aligned side-to-side to within a small fraction of the core diameter. For example, with a 5-µm core diameter, a side-to-side alignment error of more than one µm would be critical; with a 980-µm core, one µm would be irrelevant.

Core and cladding diameter. Clearly, connecting two identical cables is best. Their diameters can be different, however, as long as the smaller fiber feeds the larger one. In this case, the light from the smaller fiber enters only the middle of the larger one, but none is lost. If, on the other hand, a larger fiber feeds a smaller one, then some of the light coming out of the larger fiber "spills" outside the core of the second fiber, and light is lost.

Numerical aperture. Again, connecting two identical cables is best, because the cones of acceptance then match. If the NA is different, however, then it is best that the fiber with the smaller NA feed the one with the larger NA; in this case, the light coming out of the first fiber comes out in a narrow cone, which fits into the wider cone of the second fiber. If the opposite is true—the larger NA feeds the smaller NA fiber—then some of the light coming out of the first fiber again "spills" outside the cone of acceptance of the second fiber, and light is lost.

Pluggable connectors

Pluggable connectors come in many types; **Fig. 1** shows one kind of connector for plastic cable. Once the outer jacket is stripped from the inner core and cladding for about 1/4 inch, the fiber is slipped into the connector. Metal teeth inside the connector keep the jacket from pulling back out. The connector's manufacturer provides a metal tool which slips over the narrow end of the connector, and guides a hot knife which is used to cut the excess fiber so it protrudes just slightly from the end. The flat side of the knife is then used to melt the end of the fiber flush with the end of the connector.

Fig. 2. A semi-automatic fusion splicer.

From this description, you can imagine that this is not a very accurate or delicate process. In general, plastic cables have so much loss that most cables are short; a few dB more or less is then not considered significant, and there is no need for super precision.

The situation is quite different with glass fibers, where it is usually more important to minimize losses. Whereas plastic fibers are just cut with a hot knife, glass fibers are carefully cleaved. That is, a narrow groove is scored into

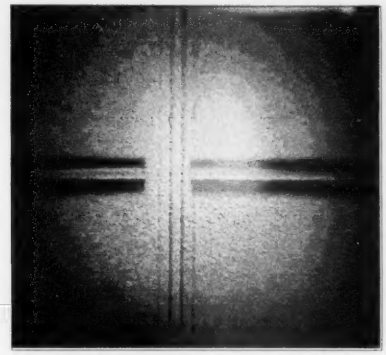

Fig. 3. Microscope display on semi-automatic splicer.

the glass, and then the glass is bent slightly until it snaps. The end of the fiber is then carefully polished, rather than just being melted with a hot knife. Sometimes, the end is polished flat; other times it has a slight convex curve.

Splices where the two fibers remain separate

Splicing two fibers so that they remain separate (as opposed to being fused together) is also done in various ways. For example, a plastic splice very similar to **Fig. 1** is available from the same manufacturer. It looks like a double-ended connector, with one fiber being slipped in from each end. As before, metal teeth hold the outer jacket to prevent the fiber from slipping back out. Since the connector itself is black plastic, it is impossible to see how close the two fibers are to each other. Fortunately, the multimode fibers are thick enough to tolerate slight misalignments.

Glass fibers, and especially single-mode fibers, require much more careful alignment. These splices are usually done with the aid of a special metal or plastic block. A small groove cut into the block holds the two fibers; once you position the two fibers in place, a cover is attached to the top to squeeze and hold the two fibers in place.

Glass fibers can also be mechanically spliced by being held together in a small tube and glued with an optical glue.

Splices where the two fibers join together

Glass fibers are most often spliced with a *fusion splice*. Here the two fibers are carefully aligned together, and then an electric arc melts their ends and fuses them together into one. Finally, heat-shrinkable tubing is slipped over the splice to hold the fibers and make the assembly rigid.

In the early days of fibers, this was a purely manual operation done by carefully trained technicians. Splicing today, however, is so frequent that there are several commercial fusion splicers on the market which make the job almost trivial.

Fig. 2 shows one such unit made by Fujikura. This splicer projects an image of the fiber onto a small microscope screen; the technician uses the controls to carefully align the fibers to get them into position, and then pushes a button to start the fusing process. **Fig. 3** shows the display during the splicing process. This particular unit is fairly small and popular with users who have to make splices in uncomfortable surroundings, such as on top of a telephone pole.

Fig. 4 shows another fusion splicer. This one is somewhat larger and heavier, but it is fully automated. Once you cut and strip the fiber, you simply insert it into the machine, and it automatically aligns and fuses the fibers. Instead of a microscope screen, this unit has a built-in TV camera which shows the process on a small LCD display screen, complete with messages at the bottom to indicate progress. It can also display the image on an external TV monitor; **Fig. 5** shows that image during splicing.

A well-done fusion splice can have as little as 0.2 dB loss; any fusion splice with a loss of 1 dB or more will generally be redone. A good non-fusion splice, on the other hand, seldom approaches even the 1-dB level.

Light sources

The light source for a fiber optic system can be either a light-emitting diode (LED) or a semiconductor laser.

LEDs are perfectly adequate for short cables. They are much cheaper, simpler to use, and also last longer.

Semiconductor laser diodes, however, have a number of advantages that outweigh their higher cost and complexity. Not only are laser diodes faster and brighter, but their main advantage, especially for longer runs of fiber, is that their light output is much more pure.

We have earlier discussed the problem of dispersion, and how dispersion limits the bandwidth of a fiber. What we did not say at that time was that the speed of light through a fiber depends slightly on the color of the light—that is, on its wavelength. The light from an LED, although it looks like a pure color (and is, in fact, much purer than the light from a colored light bulb), actually still consists of a range of wavelengths. The various wavelengths in a pulse of LED light will therefore arrive at the far end at different times, causing dispersion of the pulse. A laser, on the other hand, generates a very pure light with a very narrow range of wavelengths. Its light is therefore dispersed much less.

This is not important for lower bandwidths or short lines, but it is critical for very long lines. Hence single-mode glass fibers, which are used for long distances, are almost always used with laser sources, and many multi-mode lines are also.

Semiconductor diode lasers, however, do not last as long and are more fragile. Whereas an LED will output light over a fairly high range of currents, the current into a laser diode must be much more carefully controlled. Too little current, and the laser behaves more like an LED—too little light, and not sufficiently pure. Too much current, and the laser burns out. The laser diode also heats up much more than an LED, and its current requirements depend on its temperature. Hence diode laser assemblies often contain a second diode, which is mounted near the laser and detects its light. This diode detector is used in a feedback circuit to control the amount of current fed to the laser diode, which complicates the drive circuitry.

Fig. 4. Fully automatic splicer.

Fig. 5. TV display from the automatic splicer.

Fig. 6 shows two laser diodes, which differ only in their mechanical details. The smaller diode on the left needs a separate diode housing which would properly align and attach the laser to the fiber. The larger unit on the right comes with a short length of optical fiber called a *pigtail*. It is already aligned and attached to the diode body by the manufacturer to provide maximum light transfer; you would simply splice the end of the pigtail to the rest of your fiber.

The connection between a laser and the fiber is inherently lossy. For example, the lasers in **Fig. 6**, both made by M/A-COM, are identical GaAlAs diodes (made of gallium, aluminum, and arsenic) which typically output 7 milliwatts of light power at approximately 830 nm in the infrared range. The pigtail is an all-glass 50/125 graded index cable with a numerical aperture of 0.2, whose output is typically only 2 mW. Thus there is over 5 dB loss in the connection.

Before we leave laser diode sources, it is a good idea to just mention safety. Although power levels of 2 or 7 milliwatts seem trivial, they can nevertheless be extremely dangerous because the beam is concentrated into a very small area. If it strikes your hand, you will not even feel it. But if it should enter your eye and be focused by the lens in your eye onto the back of your eye, it can burn the retina and/or optic nerve and cause permanent blindness. Infrared lasers are especially dangerous because you cannot see their beam and may not even be aware that it is on. The standard warning on many laser devices is this: "Do not stare directly into the device or view an operating laser at close range. If viewing is required, the beam should only be observed by reflection from a matte surface utilizing an image converter or by use of a suitable fluorescent screen."

Radio Shack™ sells an inexpensive fluorescent screen that can be used to detect infrared light. CCD image sensors of the type used in camcorders are also sensitive to infrared, and can be used to view where a beam is going. But don't shine the laser beam directly into the camcorder lens, or you will burn the CCD sensor. In fact, when optical fibers are used in short lengths, attenuators in the form of dark filters have to be added to the line to prevent the detector from being damaged.

Light detectors

At the far end of the fiber, a detector is used to sense the light and convert it back into an electrical signal.

The simplest detector is simply a diode. When a diode is reverse-biased, only a small amount of leakage current flows through it, but when it is exposed to light, the leakage current increases. This increase in current can then be amplified. An ordinary diode, though, is much too inefficient, especially at the low light levels coming out of a fiber. The light sensitivity can be increased by modifying the diode.

One common photodiode used is the *pin* diode. As the name indicates, the diode consists of three layers—a P layer, an Intrinsic semiconductor layer, and an N layer. By properly doping the layers, the sensitivity can be significantly increased. An even more sensitive diode is the *avalanche* diode, which relies on the avalanche effect to internally amplify its response to light.

It is also possible to use a photo-transistor; this is simply a small transistor in a transparent case. Normally, a transistor requires a base current to conduct; otherwise there is just a small amount of leakage current in the collector circuit. But exposure to light produces charges in the base, which then lets the transistor conduct just as though there had been a base current. Phototransistors are quite sensitive, but not fast enough for high bandwidth use.

Physically, detectors are packaged in much the same ways as the LEDs and laser diodes intended for fiber optics, both with and without pigtails. Some detectors also come with built-in integrated circuit amplifiers which simplify the external circuitry.

Conclusion

There are a few points we have omitted in our discussion so far. One is this: What kind of information is sent through fibers?

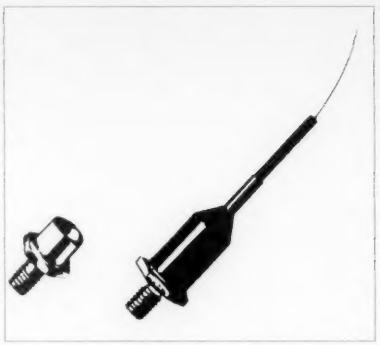

Fig. 6. Semiconductor laser diodes.

The answer is: Everything. Most fiber optics applications today are for digital data. Even when the information is analog, in most cases it is converted to digital data and then transmitted. There are a few instances where analog data is sent through the fiber by gradually varying the intensity of the light beam—cable TV is a prime example—but even this is likely to change to digital transmission as prices drop further and the technology improves. Digital TV is, after all, just around the corner.

When discussing fiber optic cables, we have also assumed that the fibers are straight, so that once a ray enters a certain mode, it stays there. In reality, fibers bend around corners and obstructions; cables hung on telephone poles will hang down between supports, and then have kinks at the point where they are attached to the pole. Even fibers that look straight have deflections that are large when compared with the wavelength of light. Light rays therefore tend to change modes inside a fiber all the time, and this does increase the attenuation as well as the dispersion.

This effect is actually increased by the construction of fiber cables themselves. Although a single strand of fiber might be fairly straight, strands that are embedded in thicker cables often lie in helical paths. They may be wound around a central metal cable which gives the entire assembly some strength, or they may lie loose inside a hollow tube, so the glass will not bend or break when the cable is heated and cooled.

One thing is certain—the last ten years have seen great strides in optical fibers. The quality has shot up, and prices have dropped. The result is that, for many applications, optical fibers are much preferable to copper wire. 73

Make a Ten-to-One Probe

Troubleshooting shouldn't be so much trouble.

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One of the most useful items of test equipment you can have in your ham shack is a cathode ray oscilloscope, more commonly called simply a scope. Now and then your scope, like any other piece of equipment, will turn up not working properly. Something has gone kerflooey and you find yourself troubleshooting. You don't have to go very far in troubleshooting one of these devices to run headlong into a problem. You'll find it necessary to measure the voltages on the several pins of the cathode ray tube (CRT) socket. In a bench service scope some of these voltages are on the order of a couple of thousand volts. There you have the problem. The digital multimeters (DMM) that most of us have on our workbenches generally won't test anything higher than 1,000 volts DC. You'll meet a similar problem if you need to dig into some linear amplifiers.

Time was when a good analog-type multimeter had a separate jack on the panel labeled "+5,000." You could put the positive probe into this jack and measure up to that level. This jack is missing on every modern DMM I've seen. What to do, then, when you need to measure, say, 2,000 volts?

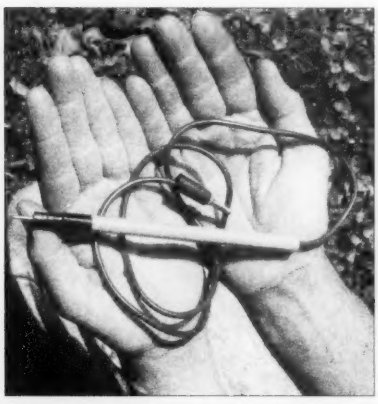

Photo A. *The author's completed ten-to-one probe.*

You need a probe that will divide the voltage by a factor of ten. That's 200 volts, and any DMM will read that with no trouble at all. This presents a *new* problem. I've never found a ten-to-one divider probe on the market. There are probes aplenty that divide by a factor of 100. TV technicians use 'em regularly. But 100–1 probes are generally very large, and although they are good for sliding under the ultor on a TV CRT, they are very unwieldy for poking around in a bench service scope. Ten-to-one probes just aren't there on the shelf. So I made one myself. It was easy and inexpensive. You can do it, too.

In making a voltage-dividing probe, the first thing to consider is the input impedance of your DMM. This is most often 10 megohms in the DMMs in use today. Yours might be different, but it's easily checked in the instruction book that came with it. You'll want to have 90% of the voltage to be measured dropped across your probe, and the other 10% across your DMM. So, if your DMM has an input impedance of 10 megohms, you need a probe that measures 90 megohms.

Most any parts supplier will be happy to sell you a handful of 10-megohm resistors. Buy nine of these in the 1/2 watt size. Tack-solder them together in a long series circuit, and measure the result. If your DMM won't measure such a big resistance, and many of them won't, see if it will measure 20 megohms. If so, you can tackle the string in portions. If it won't even do twenty megohms, you'll need to approach the problem from another direction.

Here we go

Find a place in some equipment you have that will produce a voltage of around 150 volts to 200 volts or so. The actual voltage doesn't matter much just as long as it's within range of your DMM, although in general, the higher the voltage, the better. Let's say that you have a point that measures 150 VDC. Let's call this the test circuit. Now connect one end of your embryonic probe—that is, the resistor string you just made, to that point and the other end to your DMM's positive jack. Connect your DMM's negative jack to the test circuit's ground. It goes without saying that *extreme* caution should be used here since everything will be exposed. The old adage that you should keep one hand in your pocket is not a bad idea. Also, make all connections with clip leads if you can. Then turn on the power into your test circuit. Take your reading and turn the test circuit off.

You'll have a string of nine resistors soldered together. One end will be connected to your voltage source (I like to use a lead of about 24 inches with an insulated alligator clip on each end). The other end will connect to a similar lead that will plug into your DMM. If you have exactly 90 megohms in your probe-to-be, your meter will read 15 volts. Most likely, it *won't* read this figure. This is where you must start juggling resistor values until you get the right reading.

Obviously, if your probe is over the required 90 megohms, the meter will be less than a tenth of the total resistance, and will read less then a tenth of the voltage. You'll need to bring the probe resistance down. By the same line of reasoning, if you have less than 90 megohms in the probe, the meter will

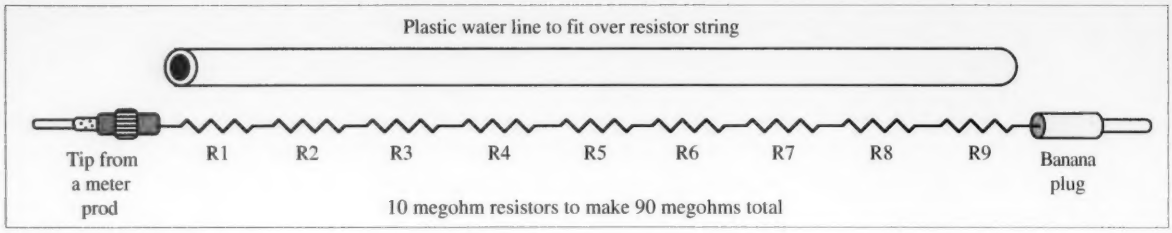

Fig. 1. *Ten-to-one probe.*

read higher than it should. It's easy to reduce the probe resistance by shunting another resistor across one of the series resistors. If the resistance must be increased, of course, you just add another resistor of suitable value on the end of the string. There's no cut-and-dried procedure in this. Sometimes it will help you get into the ballpark if you measure several resistors and try to line up nine of them that read very close to 10 megohms. Then you just use the well-known laws of series and parallel resistors until your DMM reads exactly one tenth of the voltage obtained without the divider probe in the circuit. In this manner, keep juggling resistors until you arrive at the desired reading. In our example that will be 15 volts.

In actual practice, if you can get about one-tenth of a volt under or over your target figure, you're close enough for any practical use. It helps to remember that a couple of resistors in parallel will always read *less* than the lower value of the two.

Having reached a satisfactory reading, turn off the test circuit and disconnect it from the probe you're making. Now you're ready to build the string of resistors into a real probe. Take the string apart and remake it, this time using short leads between resistors and using caution to avoid heating any single resistor unduly. Any heat on a given resistor might drive its value up and your probe won't read correctly anymore. A good dodge here is to wrap a damp cloth around the two resistors that you're working on at any given moment, leaving enough room to get your soldering iron in there. In this manner, you can use some very short connections and still avoid heating the body of the resistor. When you are done, check the resultant string again for the correct resistance, as you did before. There might a little more juggling to do to adjust for increased resistance anywhere in the string.

When all is A-OK, take a meter probe of any color and pull the probe tip out of the handle. Connect one end of the resistor string to this tip. Now set it aside, put on your plumber's hat, and take a trip to your favorite hardware store.

Plumbers use the word "water line" when speaking of the tubing that connects the cold water supply to the flush tank of a toilet. There is a type of water line made of a gray plastic which is slightly flexible. One end will be formed to enter into a fitting on the flush tank and the other end will be straight, for use in a compression fitting. The size of this water line will vary. Select one in the 3/8" size, of any convenient length. You'll want one somewhat longer than the resistor string you have waiting back on your work bench. These plastic water lines come in several different lengths. Just pick out one that's long enough. The length of plastic tube I needed was six inches. I bought one 20 inches long and cut the piece I needed.

Back in your shop now, cut off the end of the water line that has the shaped fitting intended for connection to the toilet's flush tank. This can be discarded. Next, cut the water line to a length a little longer than your resistor string plus the probe tip. This will probably be about six to eight inches.

Solder a piece of red probe lead about 30 inches long to the other end of the resistor string. Pick out a good grade of lead wire for this, bearing in mind that in use it will be carrying a few thousand jolts. Uh, that's volts!

Carefully slide your shortened water line down over the resistor string and onto the probe tip you attached to one end. It should be an easy fit, using hand pressure, to get the probe tip into the water line.

The far end of the lead finishes in whatever type of plug fits your DMM. Mine takes a banana plug. A dab of silicone rubber or any suitable cement will seal the rear end of the water line where your red probe lead exits. A short length, about an inch, of heat-shrink tubing placed over the probe tip will serve to insulate the tip somewhat, hold things together nicely, and make a fitting finish for the end of the probe. It may be necessary to use two to three sizes of shrink tubing, carefully selected, because the range of diameters from the rear of the tip to the actual point is quite broad. When the sizes and length of the pieces of tubing are selected and in place, you can bring them all to a nice shrink-fit by immersing the tip in a pan of boiling water for a few minutes to shrink the tubing, leaving a neat finish. When all the cement is set, and the water on the tip has dried, the work is all done. See **Photo A** for a view of how my probe looks.

One question that remains to be answered: What voltage does it take to puncture through the probe lead and also the water line? Most commercially-made probe wires have their rated voltage stated clearly. Good leads are generally at least five volts. Plumbers don't generally encounter such voltages, and plastic water line is not rated in this manner. Further, I lack the equipment to make such a test. I can only say that I've used my probe to check the focusing voltage of CRTs used in television sets, and this is around 5kV. At the same time, I observe certain common-sense rules, such as keeping one hand in my pocket, and making connections with alligator clips on a dead circuit, and then turning on the power to read the voltage. If I must handle the probe during the power-on condition, I hold it by the water line, since it seems to me it ought to have a higher voltage rating than 5kV. I've never been bitten yet. Anytime you work with voltages in the kV range, use *lots* of care. Truly, it is written: Electronic cooking is sometimes a slow process, and you might sizzle in your own fat for hours.

Put the completed probe in your toolbox and the next time you need to measure, say, 1,760 volts, you won't have to scratch your noggin and wonder if that voltage is OK. You'll know! 73

CARR'S CORNER

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Phased verticals?

Phased array antennas (at least in one form) consist of a pair of verticals spaced X wavelength apart (usually a half wavelength).They can produce a wonderful figure-8 pattern and show gain over a dipole. **Fig. 1** shows how a pair of verticals spaced a half wavelength apart react when fed in-phase and 180 degrees out-of-phase with each other. In **Fig. 1(a)**, the antennas are fed in-phase, so the two main lobes are found at right angles to the line between the two antennas. If the antennas are fed 180 degrees out-of-phase, on the other hand, as in **Fig. 1(b)**, then the pattern flips 90 degrees and is found along the line of centers between the two antennas. If you have a means of switching between 0 and 180 degree phasing, you not only get the gain but also the ability to control the direction of the main lobes and nulls (see "Author's Note").

So now you want to build your own single-band "roll-your-own" phased array antenna. You rush out to the Harry and Harriet Homeowner DIY hardware store and buy an armload of aluminum tubing and go to work. When nearly completed, as you connect the coaxial cable between the two antennas, you find that the books lied to you: It's not possible to finish the job.

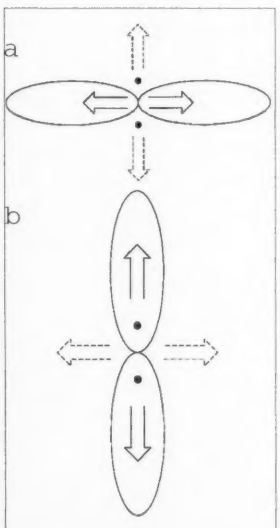

Fig. 1. Direction patterns for two verticals a half wavelength apart: (a) antennas in-phase (0°); (b) antennas out-of-phase (180°).

Why?

Well... let's consider the case where two verticals are spaced a half wavelength apart. The antennas are spaced a physical half wavelength apart (492/FMHz), but the coax must be an electrical half wavelength (492V/FMHz). The difference between the two lengths is the velocity factor (V) of the coaxial cable, which tends to be on the order of 0.66 or 0.80 depending on the type of cable used. Thus, the cable will always be too short to reach between the antennas. That's the critical fact missing in stories about the phased array.

Over the years there have been several ways to solve this problem. One method uses two different coaxial lines to the antennas from the receiver. If one is quarter wavelength and the other is three-quarter wavelength (**Fig. 2**), then the required phase shift is obtained by the extra coaxial line length. But extra coax causes increased loss, so the signal is not only not as strong as predicted but the patterns are distorted somewhat.

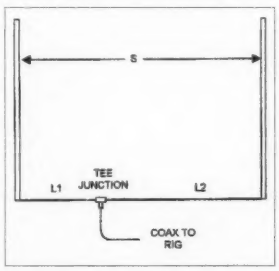

Fig. 2. One workable solution using different coax lengths.

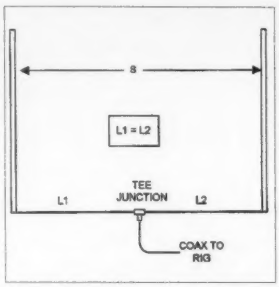

Fig. 3. Configuration of antennas using phasing box.

Well, there is one little trick that's a possible solution; see **Fig. 3**. Here we see two vertical antennas spaced S apart (for most people, I suspect S will be half wavelength, or 492/FMHz). A pair of identical length (L1 and L2) pieces of identical coaxial cable are used to connect the two verticals to a phasing box. Note that it's not important just how long those cables are, but that they be precisely, exactly and really the same length as each other. The phasing box is, in turn, connected through a third length of coax (actual length unimportant) that goes to the receiver.

If the phasing box is made switchable, then both in-phase and out-of-phase conditions can be satisfied. **Fig. 4** shows the circuit for a phasing box that I've used. The innards consist of a transformer in which three windings are wound "trifilar" style on a toroidal core. Almost any HF band toroid can be used, but I used the Amidon Associates type T-50-2 (RED) or type T-50-6 (YEL) cores for this type of project. Use fifteen trifilar turns of #14 AWG enamel insulated wire around the toroidal core. A DPDT toggle switch is used to select either zero or 180 degree phasing for one antenna input (the other input remains constant). A pair of "three-way" AC power switches can be ganged together to form a DPDT switch with RF capability.

So what's a "trifilar turn"? Good question; see **Fig. 5** for the answer. In trifilar winding three wires are kept parallel to each other as they are wound on the transformer core. Although a linear "rod" core is shown here, a toroidal core can also be used.

An improvement in the transformer can be made by using a special transformer called a hybrid combiner transformer. Perhaps in the future we will examine that subject as well.

A bit of a safety note

Both forms of phased array feed system shown in this article could involve laying coaxial cables along the ground surface or possibly elevated at levels where pedestrians could strike them. It is important that you take whatever steps are appropriate in your particular situation to ensure the safety of people passing through your property. If this means burying the coax, then bury it.

Responses

My recent columns on science fairs and ham software have produced a lot of E-mail for me. Almost all of the software comments were a hearty "amen!" and I find that quite satisfying. One chap wrote to me and asked what tools were available to write Windows© software (ham or otherwise). The tool that I use is Microsoft's Visual Basic

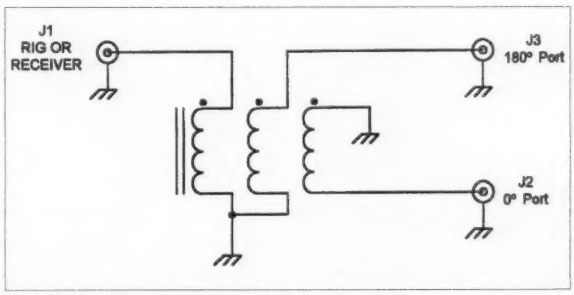

Fig. 4. Circuit of phasing box.

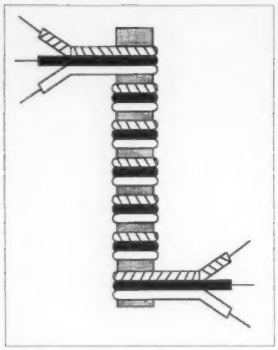

Fig. 5. Trifilar winding scheme for toroids.

language. I currently own VB 3.0 and VB 4.0, and by the time you read this will own VB 5.0. The VB 5.0 version includes a true native code compiler so programs written in that language will execute about 20 times faster than VB 3.0 or VB 4.0 programs. This feature should answer the objections of people, like producers of antenna simulation and modeling software, who complain of the slowness of early VB editions for computation of intensive programs. If you plan to write software for the ham market, then I recommend either VB 4.0 (for those who must write for Windows 3.1 environments) or preferably VB 5.0.

The science fair article generated several responses. I am heartened that the "elmering" ethic is still alive and well among hams. The next generation will only be as good as we make it... and role models are what kids need. Besides, we might generate a few new licensees.

Author's Note: Other patterns and directivities are obtained when different phasings are used. See the pattern charts created by Brown prior to World War II. They are reprinted in The ARRL Antenna Handbook (any recent edition). 73

SAY you SAW it in 73!

NEVER SAY DIE

Continued from page 53

government, our school system, our medical system, and so on. My cries of alarm are just annoying to most people, so I should shut up and go along. I should stop trying to get people to live longer, healthier lives. I should shut up about how to raise healthier, brighter children. Kids are okay, as long as they're not too much trouble.

And I should stop fretting about amateur radio losing its future to commercial interests, with its potential for growth and a payback for the use of our frequencies via a reborn electronics industry ignored by the League and our ham clubs.

Rome was destroyed by two things: the government deficit, which collapsed the empire, and the games which kept the people so busy enjoying themselves they ignored the government's folly. Today we are far too involved with ball games, sitcoms and soaps to participate in our government. So, through our neglect we have lawyers writing our laws for their benefit, and our judges are ex-lawyers. Great system... for lawyers.

If one of the many promised millennial cataclysms doesn't do us in, maybe our government will. There have been a string of empires down through history; all have collapsed, and none has ever made a comeback. Look at the Egyptians today! The Greeks! The Romans! The Spanish! The British! All had world-dominating empires at one time.

Revolution!

Yes, I'm preaching revolution. No, not with terrorist activities or an armed insurrection.

Having visited most of the major countries around the world, I can safely say that the US is the best of a sorry lot. But, on the other hand, that's not saying much, considering the major miseries we're suffering. Our school system is one of the worst in the world, a great example of socialism gone berserk. Our so-called health-care industry is an international shame, despite its astronomical ($1.5 trillion) cost. We have the highest percentage of our population in prison of any country in the world. We have a huge drug problem, despite the billions of dollars wasted pretending to fight it. And these are things that directly affect every one of us. Our legal system is a joke. Many of our judges are a joke. Our food supply system is making us sick, and so is our public water supply. Our paper "legal tender" is in the hands of an international conspiracy.

Our diet causes endless cavities which our dentists fill with mercury. Did you know that in a survey 96% of the multiple sclerosis patients were found to have mercury poisoning from their fillings?

If you're like most Americans you've been so brainwashed in public school that you have little initiative or motivation to help yourself, much less want to help others. You are sedated with ball games, sitcoms, soaps, rock music, alcohol, tobacco, brainless movies, and so on. When is the last time you read a book and really learned something? It's a heady experience.

With motivation there's almost nothing you can't do. You can take up horseback riding and become an expert rider. You can teach yourself to write, to compose music, to sculpt, to paint.

You can be totally healthy and not have the slightest worry about a heart attack, a stroke, cancer, and so on. But you'll need to start doing your homework. You're not going to be healthy if you keep on eating the same old garbage and drinking city water. This will take at least 20 years off your potential healthy life and probably make your declining years hell.

You could be making all the money you want, but not if you haven't broken loose from "the system." You probably, like me, got sucked into going to college. Four expensive, wasted years. At least the government paid for my last two years. That was part of their plan to keep millions of discharged soldiers and sailors from suddenly being dumped on the employment market when WWII ended.

College is great; you learn very little, have a great time for four years, and then you're suited for employment in a large corporation, by the government (if you can't make it in industry), or you teach. That's part of "the system." Those jobs have one thing in common: you'll never make much money. You'll never know freedom.

The revolution I'm preaching is self-education. Reading books and learning. Getting not just good at your work, but one of the best in the world at it. Bringing up a prize-winning child. Get to be an expert on more and more things and then start teaching and inspiring others.

We need kids in amateur radio. So what have *you* done about this? What has your club done? We need a million new young hams. Ten million.

In my editorials I've suggested ways to eliminate the drug problem, to cut our prison costs by around 75%, to cut school costs by at least 50% and enormously improve them, to make college tuition-free, to cut our medical costs by 80%, to get our government bureaus to enthusiastically cut themselves in half in three years, and so on. Hey, am I the only one proposing solutions to our problems? How about you? Do your homework and see what you can come up with. What did you think of my plan for making foreign aid into a profit center for the country?

Good PR

KD6CNU was kind enough to send me a copy of a half-page article about hamming

Continued on page 79

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HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
P.O. Box 2508
Fullerton CA 92633

Getting started with the right tools

Apparently 100 isn't my lucky number. After 99 successful column submissions, the first section of last month's "Homing In" never made it from my computer to *73*'s.

Let's fill in the missing information. "Homing In" for May was the first of a two-part series describing the wide variety of tools available for radio direction finding (RDF). Most are quite inexpensive and make use of receivers that you probably have already. Two meters is the most popular band for RDF activities, so that is the focus. Most of these techniques can be adapted to the 223, 440 and 1200 MHz bands. They are not suitable for bands below 60 MHz, however. That's a topic for another time.

Beams track the weak ones

Directional antennas are easy for everyone to understand and use. We all learned at an early age to point a rooftop TV antenna at the TV station's tower for the best picture. Today's kids are learning how to aim a satellite dish in the same manner. Mobile RDF with a beam antenna is just as easy and intuitive. An old two-meter yagi from the flea market may be all you need to get started.

A simple two-element beam (driven element and reflector) is sometimes adequate, but most mobile T-hunters prefer three- or four-element models because their forward lobes are much sharper. You will use the forward lobe as your direction indication most of the time—not the nulls in back—because sensitivity and accuracy are best in the forward direction.

Two companies make yagis that are particularly well suited to mobile RDF. All models from Swiech Communication Systems are rugged and have a flat black anodized finish. This makes them "stealthy" for night hunts; you will get fewer stares and interruptions from passers-by. Yagis from Arrow Antenna Company have elements made from the same material used in aluminum arrow shafts for archers (**Photo A**). These rods are about half the weight of ordinary tubular aluminum elements of the same diameter. As a result, Arrow's antennas are lightweight and easy to aim, mobile or hand-held.

Cubical quad antennas have about the same gain and directional pattern as yagis of the same number of elements and boom length. Many mobile T-hunters prefer quads because a vertically polarized yagi is taller and more of a tree snagger. VHF quads are easy to build at home with just a few dollars worth of ordinary PVC plumbing parts and wire. Complete plans for "strung wire" and "stiff wire" quads are in *TRANSMITTER HUNTING: Radio Direction Finding Simplified* by Moell and Curlee. This 323-page illustrated text, hereafter called "the T-hunt book," is available at ham radio dealers and *73*'s Radio Bookshop.

If you don't want to build your quad at home, consider the inexpensive four-element two-meter models from Cubex Quad Antennas and AAE Bandmaster Enterprises (illustrated last month). Both feature Fiberglas™ spreaders with arrow nocks at the ends to hold element wires. If you want to disassemble your antenna between hunts for storage and transport, it's easy to do so and equally easy to put it back together again.

Last month's "Homing In" explained why adjustable polarization of yagis and quads is important, and how to achieve it. I also covered Doppler RDF sets, their good and bad points, and what sources are available for purchasers and home builders. Finally, I described simple techniques for getting bearings when you get out of your car to "sniff" (close in on foot), including offset attenuators and tracking on the third harmonic.

Buzz boxes, a sniffing alternative

Dual-dipole RDF sets such as the one in **Photo B** are popular in many localities. Also called "homing sets" and "buzz boxes," they feature a pair of dipole antennas separated by a half wavelength or less, a switching device, a receiver, and a left-right indicator such as a zero-center analog meter or a pair of LEDs marked LEFT and RIGHT. They are easy to use: Just turn the unit to the left when LEFT is indicated and turn it to the right when RIGHT is indicated. There will be a sharply defined crossover of the indicator when the unit points directly toward the signal source.

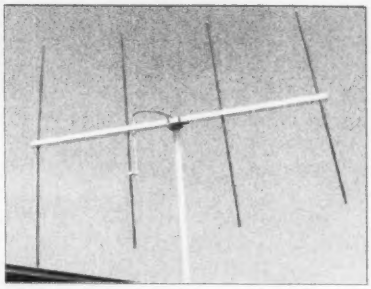

Photo A. *Arrow Antenna yagis use lightweight arrow shaft elements screwed into a hollow aluminum boom.*

The venerable L-Per by L-Tronics (illustrated last month) is the most popular dual-dipole set among hams who assist the Civil Air patrol and other agencies tracking aircraft Emergency Locator Transmitters. The L-Per uses a switched-pattern principle and includes a built-in AM receiver. This receiver can also be used to track two-meter FM signals if crystalled for a signal's frequency.

Most of the other dual-antenna RDF sets you will encounter use a different principle called either narrow aperture time-difference-of-arrival (TDOA) or phase-front detection, depending on how you prefer to explain the physics. TDOA sets are favored by hams because they are add-ons for existing VHF-FM receivers and can cover a wide frequency range.

The first TDOA RDF device for ham radio was the Double Ducky by David Geiser WA2ANU. An improved version of it, called the Simple Seeker, is detailed in the *ARRL Handbook*. A TDOA design by Paul Bohrer W9DUU in the July 1990 issue of *73* is popular with home builders. Commercial left-right TDOAs include the SuperDF SDF-2 by BMG Engineering, the VectorFinder VF-142Q by Radio Engineers, and the Foxhound DF-1 by Ramsey Electronics. In my tests, the SuperDF performed best; its synchronous detector excelled in suppressing the effects of voice and other modulation on the received signal. Avoid any buzz box that doesn't have two vertical dipoles and a method of sensing left versus right.

The one-piece configuration of most homing sets makes them well-suited for sniffing in the brush, but awkward for mobile use. The SuperDF is the only one designed to facilitate mobile use by mounting the antenna set on an outside rotating mast and locating the left-right indicator on the dashboard.

The sharp crossover indication of a TDOA is much sharper than the broad lobe of a beam. TDOAs are remarkably sensitive, but don't expect them to compete with yagis or quads when the signal is weak. When signal reflections are severe, indications will be less reliable, but you can usually use them successfully if you keep moving and mentally average out the readings.

Like Dopplers, TDOAs give no indication of signal amplitude. This is an advantage when signal level varies and means you don't need an RF attenuator with your TDOA. But it also makes it more likely that you will walk by or over the hidden transmitter without realizing it. TDOAs are also similar to Dopplers in that sensitivity and accuracy is degraded when the target signal is horizontally polarized.

Transmitter hunting is an acquired skill. No RDF set always gives accurate unambiguous indications and leads you unerringly to the target. The more you use your equipment, the more you'll understand its strong points and limitations, and the "luckier" you'll be. For your first effort, track down the local repeater as if you don't know where it is. Then get a friend to drive somewhere and transmit to you while you try to locate him or her.

After you've learned the basic techniques, you're ready to get competitive—all in fun, of course. Arrange with your club to hold

some hidden transmitter hunts. The first few should be easy so that everyone is successful and encouraged. The signal should be strong and the transmitter should be in plain sight, perhaps in the parking lot of a restaurant or at a table in a city park.

With time, hunts will get more challenging as the skills of hunters and hiders increase. You will probably want to develop some rules to even the match between hiders and hunters. Some groups are strict about the hidden T's antenna polarization, power variations, and nearness to paved roads. Others say, in effect, "Anything goes!"

Some clubs like to run the hunt like a rally, requiring the winner to have lowest mileage from the common starting point to the end. They say it discourages reckless driving, encourages careful triangulation, and evens out the competition. Sometimes the last team in is the winner, prolonging the suspense.

Other groups use elapsed time as the winning criterion. They say that time is of essence in a jammer hunt or search-and-rescue operation, so hunters must learn to find transmitters fast. Furthermore, in a time hunt there is no need to worry about the accuracy of competitors' odometer calibrations. In a few places, the hider sets the rules and they are different for every hunt.

In some areas, hunts for multiple transmitters are common. In others, one well-concealed rig is enough. Most of the time it's every team for itself, but in a few towns there are cooperative hunts on repeaters where bearings from base stations are welcome. For lots of suggestions about organizing T-hunts and making rules for them, see the T-hunt book.

Fool 'em with Mother Nature

The great attraction of T-hunting is that when you set out on a hunt, you never know where you will end up, and you never know what you'll find there. In an E-mail message last fall, Bud Hughes K4CWG of Titusville, Florida, described how John Munsey KB3GK used an antenna that was visible, but invisible: "John dug a hole and buried the transmitter, then ran the coax underground about 15 feet from the rig to a tree. Somehow he attached the center conductor to the tree, about six inches below ground level."

On a hunt like that, even a beginner can figure out that the signal is coming from the forest, but once there, who would suspect it's coming from a tree? "To my surprise, the sniffers detected quite a strong signal coming directly from it," Bud wrote. "I was taught to believe that trees don't radiate. So much for that." The 20-minute videotape of T-hunters inspecting and re-inspecting the tree made for a great program at the next radio club meeting in Titusville.

Two-meter T-hunting has taken place here in southern California for decades, and some T-hunters have been participating since almost the beginning. These veterans want to do more than just find a ham sitting in his car at the end of a street. Some of our evening hunts involve several transmitters and the boundaries extend over forty miles in some directions from the start. The monthly "all-day hunts" usually have no boundaries at all, except for the US border. They start Saturday morning and sometimes aren't over until Sunday evening.

Many all-day hunts take place along mountain trails and desert washes, making four-wheel drive a desired feature in your T-hunt vehicle. A good example of a typical all-day hunt was February's event, when longtime T-hunter Bob Thornburg WB6JPI put three transmitters along the San Sevaine Truck Trail. This road, if you can call it that, meanders for 26 miles through the mountains of the San Bernardino National Forest, beginning in Alta Loma, 35 miles east of downtown Los Angeles.

The Forest Service gate onto the road from Alta Loma was open, but the gate at the eastern end was locked tight. Bob turned on the easternmost transmitter a half hour early, and it was the only one on for the first hour. He wanted to draw the hunters east so they would find the locked gate and then have to drive all the way back through the flatlands to the Alta Loma end.

The main T ran 30 watts and was located in the middle of the Joe Elliot Campground. "You could drive and park on top of the transmitter," Bob wrote. "It went into a switchbox that selected one of eight antennas spaced over an area of about 200 by 200 feet. The antennas were AWG #30 green magnet wire that came out of the ground and tangled into a convenient bush or tree trunk. The antennas were scanned at a 1.25 Hz rate. Transmissions were twelve seconds long every 40 seconds, so each antenna was on about one and a half times per transmission.

***Photo B.** Igor Krivosheev UWØCZ learns how to use a SuperDF dual-antenna set by BMG Engineering as he prepares for an international-style radio-orienteering contest in Portland, Oregon.*

"It took 800 feet of coax in all," WB6JPI continued. "The eight antennas were simply not visible, even if you knew where to look. It was my intention that some hunters would camp there. It is a really pretty place and the view is dramatic. But the diversion to the eastern end and having to creep up the terrible road made the timing such that no one stayed. At least I don't think they did.

"The two other transmitters were 'throw-outs' along the trail. One was leaning on a tree about 10 feet off the road and about four feet beneath it. The other was located on top of a hill about two hundred feet from an even more difficult spur off the trail. It was 2.17 miles from the first T, but took about an hour to get there."

Bob's tongue-in-cheek write-up on the southern California T-hunt Web site relates tales of three-foot-deep Jeep-swallowing washouts, large rocks (one three feet in diameter), four-foot humps and a couple of full-fledged landslides. "Don Lewis KF6GQ told me via E-mail that it took him six hours to go up and back down," says WB6JPI. "After my five trips for planning setup, and observation, I got it down to four and a half hours. It helps if you know you can do it without falling off the cliff. Luckily, I don't win very many hunts or none of us would have any vehicles or equipment left."

Do you have an unusual T-hunt story for "Homing In" readers? Drop me an E-mail message or write to the address at the beginning of this article. Next time you're surfing the World Wide Web, be sure to visit the "Homing In" site [http://members.aol.com/homingin/]. Don't forget the trailing forward slash.

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PROPAGATION

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Hoo boy! It looks like the period between June 15th and 18th may be very exciting indeed! In particular, the 16th and 17th look terrible from the standpoint of high HF signal absorption (elevated Ap and Bk values as reported by WWV), and an active magnetic field reaching storm levels at times. Although the four-day period may be delayed a few days past the predicted times on our chart, it will be best to keep an ear tuned to WWV—if, indeed, you will be able to hear it—during the forecast period.

Although in June the Earth is farther from the sun than it is in December, the northern hemisphere is tilted toward the sun, which gives rise to the expected doldrums on the HF bands, so plan to do your operating during the first week or so of the month and again between the 22nd and 25th. As I write these words, the 10cm solar flux remains at very low levels, and that, coupled with seasonal lows, doesn't provide much hope for June DX.

There is always a "however" coupled with propagation reporting—sort of an escape route by which forecasters can occasionally avoid tar-and-feathering by DXers—and that is the very low sunspot and solar flux activity itself. During high sunspot activity at the peak of a solar cycle, Good (G) days and Poor (P) or Very Poor (VP) predictions are usually fairly accurate; but during the bottom of an old sunspot cycle and beginning of a new one where we are right now, magnetic field and ionospheric disturbances on Earth, caused by possible solar flares or other solar disturbances, can often jump-start HF propagation, and certainly boost VHF propagation.

So, gloomy as those mid-June days appear to be, don't ever fail to keep listening on your favorite DX bands, because pleasant surprises occur when least expected. Monitor WWV carefully at all times.

JUNE 1997

SUN	MON	TUE	WED	THU	FRI	SAT
1 G	2 G	3 G	4 G	5 G	6 G	7 G
8 G	9 G-F	10 G-F	11 F	12 F	13 F	14 F-P
15 P-VP	16 VP	17 VP	18 VP-P	19 P-F	20 F	21 F
22 F-G	23 G	24 G	25 G-F	26 F-P	27 P-F	28 F
29 F-G	30 F-G					

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
RUSSIA (C.I.S.)							20	20				
SOUTH AFRICA									15	15	15	
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
RUSSIA (C.I.S.)								20	20			
SOUTH AFRICA										15	15	20

WESTERN UNITED STATES TO:

ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
RUSSIA (C.I.S.)									20			
SOUTH AFRICA										15	15	
EAST COAST		80	80	40	40	40	40	20	20	20		

Band-by-band propagation this month

10–12 meters

Occasional intense sporadic E propagation may provide openings to 2,000 miles or more, while frequent short-skip openings out to 1,000 miles or so can occur on Good (G) days.

15–17 meters

Frequent short-skip openings to 1,500 miles and occasional long-skip openings on north-south paths across the equator are expected on Good (G) days.

20 meters

DX to all parts of the world can be expected on this band from sunrise to sunset on Good (G) days, with peak conditions usually occurring a few hours after sunrise, and again in the late afternoon. Short-skip to 2,000 miles or so may be expected as well.

30–40 meters

Consistent nighttime DX to all parts of the world is expected from sunset to sunrise, with possible exception of poor reception due to high static levels during thunderstorm activity. Short-skip openings averaging 500 miles during the daytime and 1,500 miles at night are anticipated.

80–160 meters

Nighttime DX on 80 and 160 can be fair this month, with the exception of high noise levels on both bands from thunderstorms. Daytime short-skip of a few hundred miles is possible on 80 but not on 160. Short-skip propagation is expected at night on each band and ought to be fair out to perhaps 1,400 miles or so, although limited by QRN. 73

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Food for thought

Any teacher who is using ham radio in the classroom as a motivation into the other curriculum areas knows that some of the best lessons can be tied into the social studies program. About once every two years I take a deep breath and let my 6th, 7th, and 8th grade radio students do the famous "foods project." It's such a great radio/geography exercise that I put up with the mess it tends to

create.

The last time I did this, the 8th grade decided to make a papier-mâché globe which they would fill in with foods, spices, and grains indigenous to each area we contacted. The other two grades went out and got a roll of brown butcher paper and drew a large map of the United States on it. Their plan was to fill in major regions of the country we had contacted on the air with the appropriate foodstuffs.

Since many of the children in my classes come from families that have settled in Staten Island, New York, from other countries, we decided to use their own families as a major resource. The parents were more than happy to help the children locate specific spices and grains that represented the area on the globe they had come from—and it's always a good idea to include your students' parents in a project whenever you can. It's the educationally smart thing to do. It also doesn't hurt that you'll be gaining support for your radio program.

Of course, the obvious resource we also turned to was the radio. Whenever we made a contact with a citizen of a region that we still needed help with, the children would interview the ham radio operator and enlist his help. As is always the case, the hams we contacted were delighted to help out. They were supportive of the project when the children explained what they were doing in class. The school's mailroom soon became flooded with interesting packages and letters from all parts of the world. Students would stick their heads into my room each morning to see what had arrived that day in the mail for them. It was a very exciting period.

I knew I was on the right track with this project when one young girl said to me, "It's a lot more fun to talk directly to someone to get information than to look up facts in some yucky textbook."

I thought that my Halloween pumpkin-globe project created a mess in my room, especially when the painted pumpkins began to decompose. The mess involved with the papier-mâché put the pumpkin project to shame. I definitely suggest that you get your cleanup squad well organized before you attempt this one. I was stepping on peas and seeds for weeks.

I eventually wound up breaking up each class into teams. I appointed a glue squad responsible for the neat gluing of the grains, spices, and food samples on the globe and on the floor map. Another team was responsible for the proper labeling and storing of the perishable items. I did class lessons for all the students to verify the accuracy of the items we were collecting. By the end of the third week, our ham shack looked like the inside of a food warehouse.

Because of previous lessons we've had in ham radio class, my 7th and 8th graders knew about writing to foreign embassies to get more information. It was gratifying to see some of last year's licensed youngsters so at ease with some of the more sophisticated research techniques they had learned in radio class. I was very proud of them.

The large paper map of the United States was a little easier to control because I insisted the kids use crayons and magic markers instead of paint. They were creative enough to figure out themselves that as the deadline drew near, it was acceptable to draw a small illustration, or to write in the names of the grain or spice they were unable to locate. By the time we were at the end of this project, we had managed to fill in 90% of the globe and map with actual substances.

Every time we do this geography activity, my students have fun making up puns to tell other hams on the air. They would tell other operators that they were engaged in a very "tasteful" geography project; or that their teacher was giving them some "food for thought."

The children definitely become more worldly when immersed in these fun geography lessons that are a natural outcome of speaking on the radio. The world is indeed becoming smaller, and ham radio is the perfect tool to bring the world into the classroom. If you have had success incorporating ham radio with geography and/or social studies lessons, please write to me so we can showcase your work and share the good ideas with other instructors. 73

***Photo B.** L to R: Jordan KB2PYS, Carole WB2MGP, Renée KB2QMR.*

"I was stepping on peas and seeds for weeks."

***Photo A.** Letters and packages arrived daily from all over the country and different parts of the globe. It was very exciting!*

THE DIGITAL PORT

Jack Heller KB7NO
712 Highland Street
Carson City NV 89703

Last month I talked about using your software and your packet station to connect with your local ham BBS and promised I would give some hints about getting up and running.

When we, as hams, see something we want to do, we persevere until we succeed. The paths we take, though, are almost as different as fingerprints. Some hams like to really get to know their equipment and enjoy home-brewing every part of it they can. Other hams detest reinventing the wheel and simply want to get on with the show. Cost is often a deciding factor. There is something for sale on every corner for the digital modes and your decision of what to get is personal. Not all hams have equal tastes.

There is a place and a product for everybody and I will cover as much territory as I can. I mentioned that I was using one of the commercial products (AEA's PPWIN) last month. That is a do-everything style of program that was easy to get up and running, but, sadly, AEA is no longer with us.

Though it is easy to get started, if you need to do some special configuring, you may find a few hurdles in your way. I haven't found an insurmountable problem with my system, but I have had to do a few logic sessions with it to look into the mind of the programmer who wrote it. After any of those sessions, I have always had to admit to myself that the programmer was a ham and he really wanted everything to work for us. One of the reasons I have that program is because I have the AEA PK-232MBX and it seemed logical to use software from the same supplier.

Some alternatives

Kantronics and MFJ supply some of the standard widely-advertised equipment in use by a vast number of hams. Some of you will simply want an elementary packet station. There are some good deals for you as well.

My first packet station was built around an MFJ-1270 with a Commodore 64. The software furnished with the MFJ was adequate. I found some that performed more to my liking and the whole setup cost me less than $200. I still have that equipment and put it to use in another location for a year or so. For barebones packet, MFJ can get you going for a modest price.

If you should happen to acquire a bargain Terminal Node Controller that has no software, there are a number of good programs available at the right price. Winpack is a packet-dedicated program

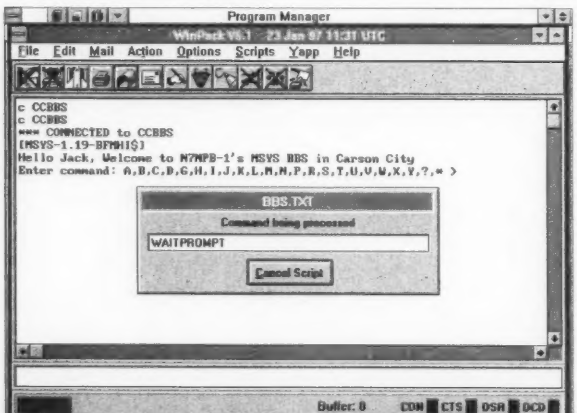

Photo A. *Winpack connected to my local PBBS, showing the welcoming text and list of commands.*

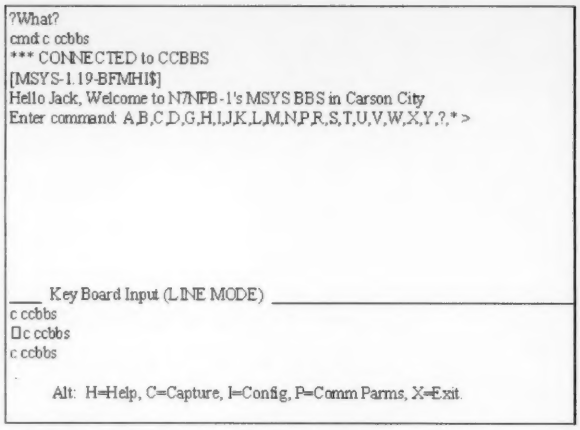

Photo B. *Packcom screen, with split operation.*

that runs under Windows© and it can be downloaded from a number of sites. I downloaded it from CompuServe, which often makes a better connection than some Internet routes and is therefore quicker (under 15 minutes with a 14.4 bps modem).

The file name is WINP610.ZIP; there are earlier versions that will be on some of the servers. I unwittingly found an earlier version in the CompuServe library and it didn't download. Lucky day—the header was there but no file. It forced me to find the correct file, which can also be downloaded from the TAPR website.

The author, Roger G4IDE, has apparently not been demanding payment for the use of the program, but since he found some of the shareware merchants had been charging for it, he has requested that we consider registering the program for £10 (ten pounds) UK—I think that translates to less than $20 US. Yes, it is written in Lincolnshire and you will get a little flavor of British wit when you read the on-line documentation.

Between the "Read Me" file and the "Help" file, there is ample information to get it up and running—maybe because the author readily admits that my PK-232 can be difficult to communicate with by way of his software: it was another program I had to get very close to before I got all its ducks in a row.

Once it began to play, it played very well. Some of its strong points are that you can have automated sessions to log onto the BBS and get your mail and search for predetermined bulletin headers and when it has done its chores it logs off with the mail and bulletins all neatly pigeonholed. It is a neat piece of work that does the job on packet the way you tell it to. See **Photo A**.

For the keep-it-basic operators, there is a small and very easy to use DOS program free for the download. I found it in the Hamnet library on CompuServe. It is Packcom and the zipped version is a little less than 60K. After downloading and unzipping, the program only takes up about 125K on your hard drive—and I found it will run under Windows, so you can run it without exiting to DOS.

I didn't time the process, but I believe I spent a total of 20 minutes getting the program set up and connected to my local PBBS. The program was written in 1987 by Jim WB4ZJV. It has a few bells and whistles and they are just the right combination. There is an alarm sound when it connects and a tone when disconnect is signaled.

The program parameters are a snap to set. It has on-line help, but the program is intuitive enough that you may never need to bring up the help. **Photo B** shows my first connection to the local PBBS.

If you go after this program from the CompuServe libraries, it is in Hamnet, Library 9, and it is named "PACKCO.ZI" which is the only hint of error I found. Something must have gone wrong

at the library end—I found it would not unzip until I renamed the file "PACKCO.ZIP" and from then on, the process was flawless.

If you are thinking of buying a TNC and software, there are several available. According to the ads, MFJ's 1270C comes with packet software and the price is right at $120. As I mentioned last month, I have one of those; it's done a job for me from time to time and has survived some punishing surges in the local power lines as well as many days at a time of continuous duty. MFJ claims to have both DOS and Windows software in the package.

Another company to consider: PacComm has a similar package. The company produces a broad line of digital equipment, and one of their offerings is a dedicated packet TNC that comes with software for $129.

There is one area I haven't touched on, and, for some, it could be the most important part of this column. That is hooking up your TNC to your radio. The TNC to the computer is usually a simple cable connection, but the TNC to the radio offers some resistance.

The TNC must get a signal from the radio that there is a data carrier present so it will wake up and decode the incoming carrier. The TNC, among all its duties, must be able to tell the radio to transmit at the correct time. The hookups to allow these processes are not necessarily easy without proper instructions.

Usually, if you purchase a new TNC and you have a popular brand of radio, the instructions for making up the cable to mate these two pieces together will come with the TNC or cables will be readily available for purchase. However, with used gear, there are too many combinations—almost every combination of TNC and radio have been mated by someone somewhere—to describe them all here. Fortunately, this information has been recorded and it is available. More next time. 73, Jack KB7NO. 73

LETTERS

Continued from page 61

I will concur that CW could be considered an art of sorts, but those who insist on its use at high speed as a filter to limit access to the HF spectrum are arguing in conflict with our charge to advance and improve our skill pools. If a National Pilots Association's goal was to increase the number of trained pilots and enhance flying technology I don't believe this would be met by requiring members to master hang-gliding techniques before they could use foreign airports.

Mr. Hanlon's bigoted thinking that we even need a filter is not surprising given the self-perpetuating nature of our hobby and its leadership selection. These "leaders" are again willing to gamble our future existence by maintaining a filter hopelessly hobbling our true potential based on the pre-destined results of a misleading, biasedly designed and badly worded "survey," not on any logical premise. Where were the questions about their current abilities and usage of CW? Where was the essay question requiring a person to support their answers with data of facts on how CW's requirement contributes to, detracts from, or is in any way necessary to participate in the service on the HF frequencies?

It seems that most hams have forgotten that primarily we are supposed to be a technically progressive service. All of us have inherited different gifts/talents. Some can be developed more than others. For many this is not a matter of being lazy or unmotivated. No amount of training will allow the truly uncoordinated to dance like Fred Astaire or enable the crayon-challenged to paint like Rembrandt or the tone-deaf to sing in harmony. But these people should not be restricted from pursuing an interest, in all its areas, that by definition is technical in nature, that is now controlled and mostly populated by those who can dance, paint, and sing.

The vast majority of the public would not pick up and use one of our licenses if they were given away on street corners. A true no-code-required, technical-based licensing system would be more than necessary to limit our hobby and band usage to the technically gifted (and hopefully innovative) users for which it was intended. With pieces of our bands being slowly whittled away for use by other services we should be looking for every possible way to attract technically motivated newcomers to our hobby and to finding new ways to reestablish ourselves as a true service, to ourselves and to our communities and nation.

Boyd Cantrell KC7JUZ, Albany OR. Most radio amateurs are not aware of the fact that the written test for their license is more difficult than the written test for a Private Pilot's License. The pilot's test consists of 60 questions. Each one has three answers to choose from. You must get 40 correct to pass. Statistically, you may guess all the answers and get one third of them correct, so if you know 20 answers you can pass.

Now the test for a basic entry level amateur radio license (no-code Technician) consists of 55 questions, with four answers each, so you can guess only one fourth of them, and you must get three-quarters of them (41) correct to pass.

If you pass and get your license you are still not really considered a ham unless you can use Morse code. Most amateurs want the General class license. That means 80 questions of which you must get 60 correct and do 13 wpm of code. That 60 is 50% more than the 40 required for a pilot's license, not to mention the Morse code which many intelligent people can not master. There are doctors, lawyers, engineers and people from all walks of life who can not get a handle on it. It is something that you just have to have a knack for. It is not even a technology—it's a psycho-motor skill which is outdated and no longer needed. The code requirement has been dropped by the US Army, Navy, and Coast Guard, as well as others, but the FCC, in trying to please a minority group known as the ARRL (which is composed of only 23% of the radio amateurs in this country), requires code proficiency for you to get a decent license.

I guess the reason that the amateur test is more difficult than the pilot's test is because the FCC doesn't want the hams to be crashing their radios into schoolhouses. I am not trying to show how silly the FCC looks, but I *am* trying to show how they have bent over backwards all through the years in trying to please the ARRL. More people are killed by private planes than by radios each year, so there is no rational way to justify the fact that a test for amateur radio is more difficult than a pilot's test. And then for the FCC to require proficiency in Morse code on top of it is on the border of asininity if not insanity. 73

Radio Bookshop

Phone 800-274-7373 or 603-924-0058, FAX 603-924-8613, or see order form on page 88 for ordering information.

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RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153

One way or another, we hams have often found ourselves at the forefront of technology, or at the crossroads of one mode and another. While many arguments can, and have, been made for or against the influx of the Internet into ham radio, one cannot deny the influence. In fact, if there is one thing maintaining the RTTY Loop Home Page has taught me, it is that there is a wealth of material directly of use to the radio amateur out there, if only it could be found efficiently.

The Radio Guide

Joerg Klingenfuss has come through, once again, with a book that neatly fills a niche in the amateur library. His new book, *1997 Internet Radio Guide*, shown in **Fig. 1**, takes on a monumental task. In it, he has assembled over 400 pages of data on sites on the World Wide Web of interest to radio amateurs. The sites range from the familiar, such as a mention of the RTTY Loop Home Page on page 269, through the exotic, such as the International Weather Satellite Imagery Center, which, for the record, bills itself as "The Internet's best source for weather satellite images" and can be found at [http://www.t-e.k12.pa.us/~dbaron/satellite/frindex.html].

Each site is not just listed, but an image of the first page is depicted, along with the complete URL, giving more of a cookbook feel to this work than just a directory listing. All of the listings in the book were obtained in the first few weeks of 1997, giving a real sense of timeliness to this work, something often lacking in the glossy directories for sale at your local computer or amateur radio store.

And just to keep everything up to date, Joerg maintains a web site were the book's URL links are all given, and can be updated. Of course, clicking on any of those links takes you right to the desired site. This has got to be the world's biggest links page!

Check it all out at [http://ourworld.compuserve.com/homepages/Klingenfuss] for this, and other fine radio publications, some of which have been mentioned here in RTTY Loop before.

AEA update

Thanks to Donovan P. Whitaker K8OMO, the *ARRL Letter*, and others who have passed along information about the turnover of AEA. As I mentioned a few months ago, AEA, the company which has been on the forefront of digital communications, closed its doors last year. Calling the situation "little orphan AEA," I alluded to the numerous times hams have been left out in the cold with equipment for which there was no support.

Well, while no Daddy Warbucks has appeared on the scene to rescue AEA, à la Annie, it appears that AEA will be selling its antennas, antenna analyzers and cable-testing equipment to Tempo Research of Vista, California. Continuing the AEA line as a separate division within Tempo, former chairman of AEA Mike Lamb will work in the marketing of this new line. There are plans to continue with new product development in the antenna line.

In another deal, Timewave Technology of St. Paul, Minnesota, is buying the rights to all other AEA products, including the digital so important to the RTTY crowd. Timewave president Randy Gawtry KØCBH has invited amateurs to check their Web site, at [http://www.timewave.com], for information on the transition from AEA to Timewave. The AEA name will remain in use for the first year of operation, with the model numbers continued indefinitely. They will handle technical support, in- and out-of- warranty service, and hope to continue new product development as well.

In the meantime, you can reach these companies by calling them at (619) 598-9677 for Tempo Research, or Timewave at (612) 452-5939. I know we all wish them both much success.

Stuff from y'all

Warren Bright dropped me the following via E-mail, the other day:

"I am not sure if you could be of any assistance. I have a friend who is deaf, and instead of using the TTY via an operator, I wondered if you would possibly have software, or know where I could obtain software, that would allow me to 'connect to,' or 'emulate' a TTY terminal using my computer and a Hayes-compatible modem. I have a 2400, and a 14.4k baud modem. If you could assist me in this matter, I would appreciate it very much.

"The only reason I am looking for such a product is that I do not like to use the operator-assisted TTY calls, and that I was told that there is software available to use my computer to talk directly to a TTY terminal."

Well, Warren, on the surface, since both TDD and RTTY use five-level Baudot/Murray code, at common speeds, it would seem that this could be a done deal. The sticking points would be the tone pairs used, whether telephone or AFSK type tones, and making sure the speed and bit patterns match. If the local telephone company office has a branch of the Telephone Pioneers club, they may be a great help to you, as the club here does a significant job with making TDD equipment available locally. Check it out, and let me know how you make out.

Richard M. Corrigan dropped me a note that read:

"Recently obtained an Info-Tech M-6000. Have a small manual and am really hooked. Do you know of any resources on the net or commercially available that will tell me more about this piece of gear?"

Well, Rich, I have asked about Info-Tech gear before, and come up empty; so here I go again. Can anyone supply Richard with info on this demodulator? Let him know, and tell me about it too. Thanks.

The last note this month comes from Julius Lewis KK4HW, who writes that he enjoys the material in RTTY Loop, and wonders where he can get some of the software we mention. Well, Julius, funny you should ask. As long-time readers of this column know, I have assembled a collection of programs of interest to RTTY hams on, currently, sixteen disks. The programs range from simple frequency lists to simple terminal programs to full featured packet and AMTOR programs and more, along with some

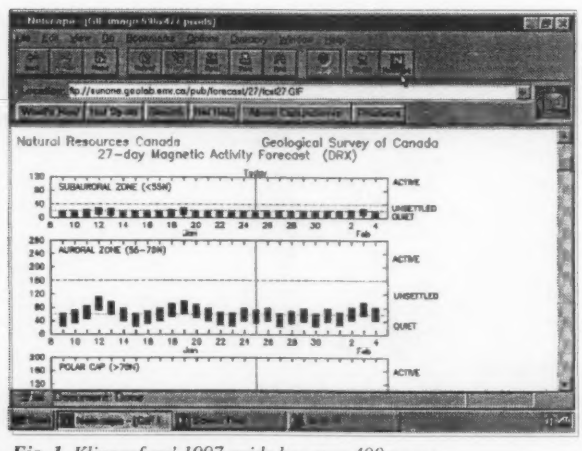

Fig. 1. Klingenfuss' 1997 guide has over 400 pages.

computer utilities thrown in. The whole listing is on line on the RTTY Loop Home Page, of course. If you have Web access, check it out at [http://www2.ari.net/ajr/rtty/]. Otherwise, send me a stamped self-addressed envelope, and I will send you a printed list of the disk contents. Each disk may be yours by sending me US $2, along with a blank disk and stamped disk mailer for each collection. As well, several of the programs are downloadable from the RTTY Loop Page; if it's a blue link, you can get it!

Believe it or not, this column closes out twenty years of RTTY Loop. Through the years I have thoroughly enjoyed your comments and questions. From the postcards and penciled notes of days gone by to the E-mail of today, it remains your input that helps shape this column, and take it into the directions that interest you. Write me at the post office box above, or E-mail me via the Web page or directly at[ajr@ari.net]. I look forward to your comments and questions as next month we begin the twenty-first year of RTTY Loop. 73

NEVER SAY DIE

Continued from page 70

from the Sonora (CA) *Union Democrat*. It was a nicely done article which I hope will nudge some people into the hobby. It mostly discussed our emergency communications services and didn't go much into the other benefits of the hobby—such as making it fun to learn about radio and electronics, the new group of friends you meet, and the fun of talking with people anywhere in the world.

If your local paper runs an article on hamming, please send me a copy. If they haven't run at least one article about hamming a month, then get yourself in gear and make it happen. Make sure that your club has a PR person and that this person is out there with a camera and laptop on Field Day, plus any other club activity. We need newspaper, radio and TV coverage in your town. None of this is going to happen unless you do it. And stop looking around for someone else to get moving. Yes, it takes motivation and initiative—well, you've got those in there somewhere, haven't you?

It's Too Late

Well, it's probably too late for you to be interested in work advice, but maybe you can help your kids or grandkids by cluing them in on how to beat the system. Almost no one does—it's a mighty powerful system, held in place by our school system and the media, which is run by products of the school system.

When we get out of school we're now "educated" and looking for a job so we can make money.

Will we settle for a job, or will we plan ahead and lay the foundation for a career?

A job will put food on the table next week. A career will keep it on the table for a lifetime.

Most jobs, no matter how boring, can be turned into learning experiences, and can lead to a career. Ask yourself, what are the possibilities if I get to be one of the best people in the world at the job I'm doing? Well?

If you were to read books and subscribe to magazines on the subject, or take classes—if you were to attend seminars, network with other people doing similar work, could you get good enough at what you're doing to write about it and teach others what you've learned? Maybe start a newsletter? Are there ways to use new technologies (like computers, closed circuit TV, pagers) to improve what you're doing?

Of course, if you haven't bothered to keep up with new technologies, then you aren't going to see ways to adapt them to your work.

You know, I've had over a thousand employees over the years, but I can't think of one who ever pestered me to learn more about his work. Oh, I tried to get 'em interested in reading relevant books and magazines so they'd be more productive—so they'd be of more value to me and themselves. I've attended some wonderful lectures and made tapes of them available. I never was able to get anyone interested enough in building their skills to listen to the tapes or read a book.

And that's a shame, because the world is wide open to anyone willing to make the effort to learn. Somehow the idea seems to have been firmly implanted by our blessed school system in just about every mind that once you're out of school you don't have to waste any more time learning stuff. You're now educated. Period. And never mind that around 99% of the "learned" stuff has been long forgotten. Or that less than 10^{-3} of it will ever be relevant to your work.

Hmm, let me modify that open world claim. That doesn't hold for certain types of semi-dead end jobs—such as working for a large corporation. Or for government jobs. Or teaching. All proven ways to never score big in the world. No, my advice is aimed at helping people to make a real life for themselves while working for a smaller company. Almost any kind of smaller company.

Of course, if you prefer the security of the office-politics hive-type life in a large corporation you still can benefit from doing your homework. But you'll get more benefit from books like *The Dilbert Principle* by Scott Adams. Look busy, keep your head down, and wait for retirement. Then die. Or get downsized or outsourced, and wonder what happened!

Now that I've read a stack of books on our school system, I see school as a way to spend twelve years on what can be learned in a couple, and with only a tiny fraction of it relevant or of any long-term benefit to you. College? Well, I suppose we have to have some physicists and economists. Hmm, I wonder who hires 'em? Other colleges, I'll bet. Well, once tenured, it's not a bad life. A couple hours a week (or less) of actual teaching. A good retirement program when you're too old to get much benefit from it. Most of it is publish or perish, parsing minutiae. The pay is adequate, though the standard of living required strains it.

I just wanted to get you thinking, not turn this into a handbook.

Secrets

Several of the exposé shows that *60 Minutes* has spawned have had recent segments interviewing survivors and the children of those involved with the Roswell "incident." One chap was a supply sergeant who cited the records he made at the time on the cost of flying in a special cargo plane to take away the debris that had been collected. He talked about the room where they kept the alien corpses, and the large number of troops sent to scour the crash site for debris. Weather balloon, eh? Sure. The children of local residents all claim that the military threatened them with the death of them and their entire family if they didn't keep everything a secret.

Now, re the moon. The government cover-up at Roswell and threats have had a consistent pattern which makes them difficult to ignore. The amazing thing is that the government has been able to keep the story buried for almost 50 years.

But then, as I've written several times, and gone into some detail in my WWII submarine adventures book, the government is still actively covering up the Amelia Earhart story. Through serendipity I happened to know about her spy mission before her flight. Her mechanic, Bob Wemple, was a good friend of my father's and he told us the whole story one night when he was visiting for dinner.

My father was an aviation pioneer. He went around the country, compiling the first book on American airports for the Department of Commerce back in the 1920s. He had pilot's license #73 and commercial pilot's license #89. I remember as a kid our going to air shows where he would check out all of the planes before the show by taking them up for a quick flight. I suspect he has the record for the most different kinds of planes flown by one man in one day.

In the late '20s he designed, built and managed Central Airport, the main airport for Philadelphia. This is where Amelia kept her Lockheed, which I used to climb all over as a kid. She,

Continued on page 83

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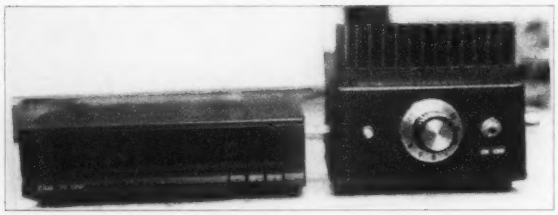
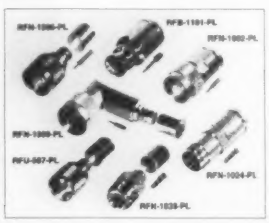


Pauldon Associates has a nifty hyperband video modulator for ATV operation on the 70cm band—compact, sturdy, and handy to use. The hyperband exciters from Pauldon start at $125 and have a front digital display to indicate the channel in use. Pauldon Associates also makes companion power amplifiers—the one shown here is the PD-440NA, with switch and indicator light on the front panel. The PD-440NA and its sibling, the PD-440NB, are both available with T/R switching. If you get the power amplifier and the exciter together they're $338 (without T/R switching, $288), and you'll have the power you need for sharp, brilliantly-colored video and clear audio. For more information, contact Don Fuller W2WHK at Pauldon Associates: 210 Utica St., Tonawanda NY 14150; phone or FAX (716) 692-5451.

"Island" Memories

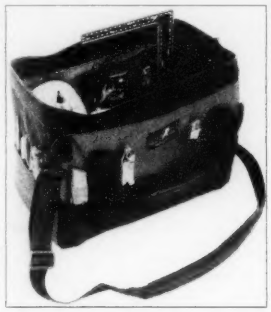
No, not vacation slides from Jamaica. It's the WB9KZY "Island" Memory Keyer kit, and Milestone Technologies is delighted to offer it complete for only $21.95 (+$3 s&h). The thing is so tiny (1.5 x 2") you have to see it to believe it—you can mount one of these inside the smallest QRP transceiver. It has four separate memories, a straight-key input, a sidetone oscillator, and speeds from seven to 48 wpm.

The Island Keyer kit includes the circuit board and all board-mounted components—anything else you need is readily available at your neighborhood you-know-what. For an additional $12, you can get the hardware, too! If you order the kit *and* the hardware, you pay only one shipping & handling fee. Send check or money order to: Milestone Technologies, Inc., 3140 S. Peoria St. Unit K-156, Aurora CO 80014-3155. Call toll-free (800) 238-8205 for credit card orders; for more information, call (303) 752-3382.



Make New Connections

RF Connectors, a division of RF Industries, has released several BNC, N, and UHF connectors designed for use with RG-8U cable, which, as every ham knows, is as ubiquitous as duct tape. These shiny new connectors will liven things up, so see your RF Connectors distributor, call (800) 233-1723 or E-mail [102061.2261@compuserve.com].



Grand Opening!

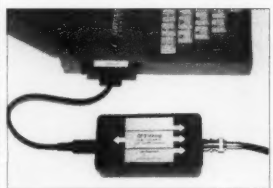
The name says it all—Paktek's latest addition to their Toolpak® line is the ProTote™, offering you Grand Opening™: wide-open, one-zipper access to your tools and supplies. Just about whatever you need to carry fits in the 12 outside or 16 inside pockets, and the ruggedly built ProTote handles most conditions. It's made of waterproof fabric, has a rigid bottom for stability, padded handles, and D-rings for attaching the optional shoulder strap or other necessary items. Order ProTotes from Paktek, Inc., 7307 82nd Street Court, Tacoma WA 98498. Phone (206) 584-4914; FAX (206) 589-1091, or visit the Web site at [www.toolpak.com].

Shack Attack!

No, this is a *good* thing. It's a catalog from some ham folks in Utah (P.O. Box 91, Enterprise UT 84725). There's stuff to buy, stuff to chuckle over, a project, and a real good attitude. They're featuring a new item, the "Ham Gallery." Display your QSL or favorite ham photo in this sturdy acrylic easel frame, with your call custom laser-etched across the bottom.

Get your copy of the catalog *now*. Write Shack Attack at the P.O. box; FAX (801) 878-2100; call (801) 878-2760; E-mail [kb7vrd@aol.com] or check out their Web site at [www.vcnet.com/sa]. Just get your own. This one's *mine*.

OFS WeatherFAX's Viking



The Viking is a high-performance computer-controlled synthesized VHF satellite receiver—in a miniature low-cost ($445 with software) unit made for use in harsh mobile, portable and base station environments. It works with the companion PC Card (PCMCIA) satellite decoder, allowing satellite technology to be used with laptops and desktops, bringing it wherever it's needed. Fishermen, teachers, pilots, and anybody else who needs weather information *right now*, *right here*, rejoice!

There's nothing to adjust—all options are set using the Viking software. It's only slightly larger than a deck of cards, in a rugged case, and since it's powered by the computer, you don't need an external power source! It could save your life… or maybe your camping trip… so check it out at your dealer or by phone/FAX at (919) 847-4545; E-mail at [jdahl@worldnet.att.net].

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the October issue, we should receive it by July 1. Provide a clear, concise summary of the essential details about your Special Event.

ANNOUNCEMENT

FRIENDSHIP, WI Due to circumstances beyond control, the Adams County ARC '97 Hamfest scheduled for June 1, 1997, has been cancelled. Plans are already in place to hold a much larger and expanded hamfest on June 7th of next year.

JUN 1

GRAND RAPIDS, MI The annual IRA Hamfestival will be held at Hudsonville Fairgrounds near Grand Rapids. Doors open at 8 AM for general adm. Dealers can set up on the 6th after 7 AM , or after 6:30 AM on the 7th. Overnight camping. Bring your equip., etc., to sell and trade. VE exams at 8:30 AM. Talk-in on 147.16 link rptr system. Reserve early for the best spots. Indoor table space and trunk sales spaces available. Contact the *IRA voice mail/info line* at *(616) 534-6803;* or *Tom KA8YSM,* or *Kathy KB8KZH,* at *(616) 698-6627.*

NEWINGTON, CT The Newington Amateur Radio League will hold its annual Ham Radio Flea Market at Newington H.S., Rte. 173, from 9 AM–1 PM. Dealer setup is at 8 AM. Tailgating, refreshments. Tables are $15 in advance (make check payable to *NARL* and send with an SASE to *Ed Matthews KC1JV, 69 Wildemere Ave., Waterbury CT 06705).* Tables are $20 at the door. Adm. $4. VE exams at 10 AM by pre-reg. only, to *Paul Sheldon N1LJA, 1509 Summer Hill Dr., S. Windsor CT 06074. Tel. (860) 875-6246.* For general info, call *Fred Jarvis N1KWJ, (860) 666-1952.*

QUEENS, NY The Hall of Science ARC Hamfest will be held at the New York Hall of Science parking lot, Flushing Meadow Park, 47-01 111th St. Vendor setup at 7:30 AM; buyers admitted at 9 AM. Free parking. Adm., buyers $5, sellers $10 per space. Talk-in on 444.200 WB2ZZO rptr, and 146.52 simplex. For more info, call, eves. only, *Arnie Schiffman WB2YXB, (718) 343-0172.*

TEANECK, NJ The Bergen ARA will hold its annual Spring Hamfest at Fairleigh Dickinson Univ. Buyer adm. $3, with XYLs and harmonics free. Seller adm. $10. VE exams. Talk-in on 146.790/.600. Contact *Jim Joyce K2ZO at (201) 664-6725 before 10 PM.*

JUNE 7

LEMPSTER, NH The Connecticut Valley FM Assn. will hold their 7th Annual Hamfest, 8 AM-3 PM, at Goshen-Lempster Coop. School, Rt. 10, 10 mi S of Newport NH, 25 mi. N of Keene NH. VE exams and demos will be featured. Adm. $1. Table/space $6, includes 1 adm. Talk-in on 146.76. Contact *Conrad Ekstrom WB1GXM, P.O. Box 1076, Claremont NH 03743. Tel. (603) 543-1389. E-mail: [goshlem @srnet.com].*

JUN 8

CHARLOTTE, NC The 5th Annual Charlotte ARC Hamfest & Computer Fair will be held Sunday, June 8th, at the Roll-A-Round Skating Center, 8830 East Harris Blvd., 8 AM-4 PM. This is an ARRL-sanctioned hamfest. There will be computer and radio dealers as well as about 200 flea market tables. Limited tailgating. Flea market setup is 6 AM-8 AM. Adm. $4 in advance, $5 at the door. Children 12 and under are admitted free. Tailgating is $5 per space. Adm. tickets are included with the purchase of 2 or more spaces, and are available for $2 for tailgaters requesting only one space. The selling or solicitation of pornographic-type material is prohibited within the indoor or tailgating areas. Flea market tables are $8 in advance, $10 at the door. Chairs are $1 ea. Pre-reg. requests should be sent with an SASE to *Charlotte ARC, P.O. Box 33582, Charlotte NC 28233-3582.*

ERLANGER, KY The Northern Kentucky ARC will hold "Ham-O-Rama '97" at the Erlanger KY Lions' Park. Prizes and forums. ARRL-sanctioned. Indoor exhibit area for major vendors. Extensive outside flea market with setup at 6 AM. General admission begins at 8 AM. Adm. $4 in advance, $5 at the gate. Children under 13 admitted free. Flea market spaces $2 each (with purchase of gate ticket). Bring your own table and chair. Indoor vendor spaces $15 per table (provided) and one gate admission. Location: Erlanger Lions' Park, I-75 to Exit 184 (Rte. 236 East). Go one mile to Dixie Hwy (U.S. Rte. 25 & 42). Turn right and go one mile to Sunset Ave. Right on Sunset to end of street. For more info or advance registration, contact *N8JMV, c/o NKARC, P.O. Box 1062, Covington KY 41012;* or call *(513) 797-7252 eves.* Talk-in on 147.255(+) or 147.375(+) rptrs.

WHEATON, IL The Six Meter Club of Chicago, Inc., will hold their 40th Annual Hamfest at the Du Page County Fairgrounds, 2015 Manchester Rd. [N of Roosevelt Rd. (Rte. 38), E of County Farm Rd.], rain or shine. Advance tickets $4 for everyone over age 12; $5 at the gate. Advance tickets are available from *Joseph Gutwein WA9RIJ, 7109 Blackburn Ave., Downers Grove IL 60516,* or from any club member. Commercial tables (8 ft. w/110 V) main bldg, air cond., $15 ea.; indoor flea market tables, 8 ft., no electric, $10 ea. Limited overnight RV parking (includes elec. hookup), $10 ea., advance registration required. General parking at the west gate, sellers only at the east gate. Gates open at 7 AM. Indoor setup for pre-registrants is at 7 AM. Buildings open to the public at 8 AM. Talk-in on K9ONA 146.52 and K9ONA/R 146.37/.97 (107.2). Absolutely no alcoholic beverages permitted. VE Exams, all elements, 9 AM-1 PM. For more info, call the *24-hour InfoLine at (708) 442-4961.*

JUN 12 & 26

FORT WORTH, TX The Lockheed ARC and the Kilocycle Club of Ft. Worth are sponsoring test sessions for all license classes. They will be held at the Lockheed Rec. Area Facility, 2400 Bryant Irvin Rd., Ft. Worth TX, at 7 PM. For details call *Ted Richard AB5QU, (817) 293-6745.* G.R.O.L. testing done by appointment only.

JUN 13-14

ALBANY, GA The ARRL Georgia Section Convention (15th Annual Albany Hamfest and Computer Fair) will be held at the Albany James H. Gray, Sr., Civic Center. Doors open to the public Fri., 5-9 PM and on Sat., 9 AM-4 PM. Features include VE exams Fri. at 6 PM, outdoor flea market Sat. only ($10), forums and free parking. Talk-in on 146.82. Adm. $5 at the door. Contact *Arthur Shipley N4GPJ, c/o AARC, P.O. Box 70601, Albany GA 31708-0601. Tel. (912) 439-7055.*

JUN 13-15

RED DEER, ALBERTA, CANADA The Central Alberta Radio League will host its 27th Annual Picnic and Hamfest at the Burbank Campsite located approx. 8 km NE of Red Deer. Talk-in on 147.150(+600) or 146.520 simplex. For info, contact *Bob VE6BLD, 5540 54th Ave., Lacombe, Alberta, Canada T4L 1L6. Tel. (403) 782-3438 eves. FAX: (403) 782-3438. Packet: [VE6BLD @VE6RDR.AB.CA].* Or call *Janet VE6JGM at (403) 340-3498; packet: [VE6JGM@VE6RDR.AB.CA].*

JUN 14

BANGOR, ME The Bangor Hamfest will be hosted at Hermon H.S., 0800 hrs.-1300 hrs. by the Pine State ARC. Travel on I-95 to exit 44 (Cold Brook Rd.) to US #2. US #2 west 1 mi. to the high school. From the village, take US #2 east 1/2 mi. to the school. Tailgaters, dealers, VE exams for all classes, hamfest, ARRL and section forum. Rain or shine. Adm. $3 per person, under 12 free. Talk-in on 146.34/.94 and 146.52. Tables are $8 ea. Demonstrations feature frequency calibration, QSL card displays, old ham gear, key collections, home-brew equip., Hermon new type 3 ambulance, Zoll defibrillator, free blood pressure check. There are campgrounds and many motels within 5 miles. Contact *Roger W. Dole, RR #2, Box 730, Bangor ME 04401. Tel. (207) 848-3846.*

MIDLAND, MI The 22nd Annual Hamfest of the Midland ARC will be held Sat., June 14th at Midland County Fairgrounds 8 AM–1 PM. Set up at 6:30 AM. Admission is $4, advance reserved tables $6 ea., trunk sale space $5. Featuring amateur radio, personal computers, new and used equipment, trunk sales, VE exams, software, coax, etc. Talk-in on 147.00(+), Midland. For more info, write *MARC Hamfest, P.O. Box 1049, Midland MI 48641.* Please SASE, or call evenings or weekends, *(517) 839-9371 or (517) 496-2999.*

PADUCAH, KY The Paducah ARA is pleased to announce that the 1997 "Dukefest" will be held Sat.,

June 14th, at the Executive Inn Convention Center 9 AM–3 PM. Free parking. VE exams will be held at 1 PM. Adm. $5, tables $6, with one free ticket per vendor. Contact *Craig Martindale WA4WBU, 2509 Trimble St., Paducah KY 42001. Tel. (502) 444-6822* or *(502) 443-3860.* E-mail: *[KC4ENA@APEX.Net].*

JUN 15

BLUEFIELD, WV The Bluefield Hamfest will be held 9 AM-3 PM at the Brushfork Armory on US 52, one mi. north of Bluefield. VE exams at 9 AM at Bluefield State College, 1 mi. south of the hamfest. Walk-ins accepted. Hamfest adm. $5, senior citizens $4, children under 12 free. Tables $5 ea. Inside flea market and dealers. Paved parking and wheelchair access. Talk-in on 145.49 (BR549) rptr. For more info, send SASE to *Bluefield Hamfest, Inc., 412 Ridgeway Dr., Bluefield VA 24605-1630,* or E-mail: *[wa4k@amsat.org].* Dealers contact *Bob Frazier WB8NRK at (304) 425-8464,* or E-mail: *[cna00188@mail.wvnet.edu].* See our Web site at *[www.inetone.net/erarc/hamfest.html].*

CAMBRIDGE, MA The MIT Electronics Research Soc., the MIT Radio Soc., and the Harvard Wireless Club will be holding a tailgate electronics, computer and amateur radio Flea Market Sunday June 15th, 9 AM-2 PM, at Albany and Main Streets. Adm. $4. Free off-street parking. Sellers $10 per space at the gate, $9 in advance (includes 1 adm.) Set up at 7 AM. For space reservations or info call *(617) 253-3776.* Mail advance reservations before June 5th to *W1GSL, P.O. Box 397082 MIT BR, Cambridge MA 02139-7082.* Covered tailgate area available for all sellers, rain or shine. Talk-in on 146.52 and 449.725/444.725 pl 2A W1XM/rptr.

CROWN POINT, IN The annual "Dad's Day" Hamfest, sponsored by the Lake County ARC, will be held at the Lake County Fairgrounds, Crown Point IN. Talk-in on 147.00, 146.52 and 442.075. This year there will also be computers, software and hardware vendors. Setup at 6 AM. Doors open to the public at 8 AM. Adm. is $5 per person; tables $6 ea. Contact *Malcolm Lunsford WN9L* for reservations, *Callbook* address, or *[72202.230@compuserve.com].*

JUN 21

DUNELLEN, NJ The Raritan Valley Radio Club's "97 Hamfest" will be held at Columbia Park, near the intersection of Routes 529 and 28. Sellers 6 AM, buyers 7 AM-2 PM. Admission $5 for buyers, sellers $10 ($5 each additional space). Talk-in on 146.625(r), 447.250(r), tone 141.3, 146.520(s). Contact *Bob Pearson WB2CVL, (908) 846-2056 [RWPEARSON-WB2CVL@WORLDNET.ATT.NET],* or *John Manna WA2F, (908) 722-9045.* To pre-register, contact *Chuck Fainsbert KC2NB, (908) 873-2198,* or E-mail: *[FAINSBERT@WORLDNET.ATT.NET].* Please call before 8 PM.

MARMORA, ONTARIO, CANADA The Tri-County ARC and the Northumberland ARA will co-sponsor the 1997 Eastern Ontario Hamfest & Computer Flea-Market at Marmora Area Curling Club on Crawford Drive. Adm. $3, children under 12 free. Tables $10, one admission included per table. Tailgaters $6. The event will be open 9 AM–2 PM, with vendor setup at 7 AM. Contact *Pete VA3PGB at (613) 473-1171,* or *Richard VE3BZY at (613) 473-2665.* The E-mail address is *[rhobson@blvl.igs.net].* The Web site is *[www.redden.on.ca/home/~hamfest/index.html].* Paul VE3UUM will take packet messages at *[ve3uum@ve3hqr.#econ.on.can.na].*

JUL 4

DILLSBURG, PA The Harrisburg ARC will hold its Firecracker Hamfest 8 AM–2 PM at the Monagahan Fire Hall, 245 W. Siddonsburg Rd., Dillsburg PA. VE exams start at 9 AM. Talk-in on 146.16/.76 MHz. For info and table reservations phone the *HRAC AnswerLine at (717) 232-6087.*

JUL 5

SALISBURY, NC The North Carolina Alligators Group "Firecracker Hamfest" will be held at the Salisbury Civic Center, 8 AM–1 PM. Admission is $3 in advance (with an SASE), or $4 at the door. Free to XYLs. Auction of goods will be at 1 PM. Dealer setup at 6 AM. Tables in the air conditioned center are $5. Outside flea market spaces are free. Contact *Walter (Alligator) Bastow N4KVF, 3045 High Rock Rd., Gold Hill NC 28071.* Talk-in on 146.625. Directions: From I-85, take Hwy. #52 West/East Innes St., turn left on South Boundary St. The hamfest is on the left.

JUL 12

OAK CREEK, WI The South Milwaukee ARC, Inc., will hold its annual "Swapfest" on Sat., July 12th, at the American Legion Post #434 grounds, 9327 S. Shepard Ave., 7 AM until at least 2 PM CDT. Free parking, picnic area, and free overnight camping are available. Admission, $5 per person includes "Happy Time" with free refreshments. Free flyer by writing to *The South Milwaukee ARC, Inc., P.O. Box 102, South Milwaukee WI 53172-0102. Tel. (414) 762-3235.* Talk-in will be on 146.52 simplex as well as on many of the local repeaters.

PETOSKEY, MI The Straits Area ARC will host a Swap & Shop in the 4-H Bldg. at the Emmet County Fairgrounds. Talk-in on 146.68(-) and 146.52. Contact *Jim KC8FFS at (616) 537-2422* for details. For VE exam info, call *Floyd KG8CS at (616) 526-5503.*

JUL 12-13

INDIANAPOLIS, IN The Indianapolis Hamfest will host the ARRL Central Division Convention as well as feature huge ham, computer, and electronics show. Marion County Fairgrounds, easy access from I-465 and I-74. Commercial exhibits, flea markets, forums, banquet, overnight camping available, homebrew contest, T-hunts, prizes, more. Write or call *Indianapolis Hamfest Association, P.O. Box 88677, Indianapolis IN 46208; tel. (317) 251-4407; [www.indyhamfest.com].*

SPECIAL EVENT STATIONS

MAY 31–JUN 1

HOUSTON, TX The Clear Lake ARC will operate K5HOU, or their own calls, 0000 UTC May 31st–2300 UTC Jun 1st. The event will be the 3rd annual "Hurricane Party," marking the beginning of hurricane season in the Gulf of Mexico, and promoting Hurricane Awareness. Operation will be on the General portions of the HF bands, plus KA5GLX rptr. at 442.75 MHz, tone 103.5. For a certificate, send QSL and a 9" x 12" SASE to the station worked.

JUN 7

ST. CLOUD, MN The St. Cloud ARC will operate WØSV/75 to commemorate the club's 75th Anniversary, from 0000Z–2359Z. Freqs.: CW—28175, 21175, 14075, 7125, 3700, and 1875; SSB—28375, 21375, 14275, 7272, 3875, and 1975. QSL and certificate can be obtained by sending a 9" x 12" SASE to *WØSV, St. Cloud ARC, 401 4th Street N., Waite Park MN 56387.*

JUN 7–8

BOWLING GREEN, KY Station KB4ALC will be operated 0000 UTC Jun. 7th–2400 UTC Jun. 8th, by the Western Kentucky DX Assn., in celebration of the 1997 Corvette Homecoming. Operation will be on 3.860, 7.235, 14.235 and 21.310 MHz. A special certificate is available from *Kenneth E. Newman KB4ALC, 505 Emmett Dr., Bowling Green KY 42101.*

JUN 14

FULTON, NY The Oswego County Amateur Radio Emergency Service, Fulton ARC, and Experimental Aircraft Assn., Chapter 486, will operate KY2F 1200Z–2100Z from the Oswego County Airport in conjunction with Young Eagles Day. Operation will be in the lower half of the General 80, 40, 20, 15 and 10 meter phone bands. For a certificate, send your QSL card and a large SASE to *KY2F, Box 5281, Oswego NY 13126.*

JUN 14-15

STEUBENVILLE OH The Weirton (WV) ARC will operate W8CWO, 1500Z–2200Z Jun. 14th, and 1500Z–2200Z Jun. 15th, to celebrate the Fort Steuben Bicentennial. Listen for them on 7270, 14270 and 28470 MHz. For a certificate, SASE to *Bill Leist WA8DRL, 2444 Alexander Manor East, Steubenville OH 43952.*

JUN 21–22

VANCOUVER, WA The Clark County ARC will operate special event station W7AIA 1600Z–2400Z June 21st and 22nd, to celebrate the grand reopening of Pearson Air Museum, and the 60th anniversary of the Russian Transpolar Flight. Activity will be on the General phone subbands at 80, 40, 20, and 15 meters, and Novice/Tech phone subband on 10 meters. To obtain a certificate, send a #10 (business-size) SASE to *CCARC, 4211 NE 140th Ave., Vancouver WA 98682.*

WELLSBORO, PA The Tioga County ARC will operate WO3C

1400Z June 21st–1800Z June 22nd, in commemoration of Amateur Radio Awareness. Operation will be on 3.860, 7.250, 14.250 and 28.375 MHz. A special QSL card and certificate are available. Write to *Darlene Rahn, RR #6 Box 200, Wellsboro PA 16901-8972.*

JUN 26

SAN BERNARDINO, CA The Citrus Belt ARC plans to operate W6JBT, 1600Z–0400Z, to commemorate the 50th Anniversary of the Citrus Belt ARC. W6JBT will operate SSB on 3.850, 7.240, 14.250, 21.350; CW on random frequencies, 2m phone and 2m packet. For a certificate, send QSL and a 9" x 12" SASE to *W6JBT, P.O. Box 3788, San Bernardino CA 92413.*

JUL 3-5

NEAR ROSWELL, NM An Amateur Radio Special Event Station will operate 1700 UTC–2400 UTC, daily, July 3rd, 4th, and 5th, to celebrate the 50th anniversary of the "Crash at Corona" near Roswell NM. Frequencies: Approximately 20 kHz up from the bottom edge of the General HF band edge, 6–40 meters (phone and SSB), and in the Novice/Technician (CW) HF section of 15 and 40 meters. Listen for W5BI, WB5LYJ, NA5N and WA5WHN. The station will operate overlooking one of the debris fields near Corona NM. SWL reports are encouraged, too. SASE required. Send a 9" x 12" SASE and 2 units of US first class postage, along with your QSL card to *Jay Miller WA5WHN, P.O. Box 6552, Albuquerque NM 87197-6552.* Check the W5BI Web page *[http://www.flash.net/~w5bi/]* for further developments, or E-mail: *[wa5whn@juno.com].* 73

Radio Bookshop

Phone 800-274-7373 or 603-924-0058, FAX 603-924-8613, or see order form on page 88 for ordering information.

Wayne has a whole bunch of booklets you'll enjoy — like How to Make Money, The Bioelectrifier, WWII Submarine, Caribbean, and other Adventures, Editorial Collections, Instant Morse Code Course for the truly lazy, Reading Guide, Cold Fusion, and etc. Ask for FREE 16p list of WAYNE'S STUFF.
Order **Wayne's Stuff**

NEVER SAY DIE

Continued from page 79

and many other aviation pioneers, used to come over for dinner at our house.

Anyway, the government is better than many of us think at keeping secrets. Look at the job they did with the atom bomb project!

Even so, I'm as resistant as most of you to conspiracy theories. Hey, we have all kinds of kooks out there. This is being proved every day, so it's normal to tend to be skeptical of strange stories with little supporting data. As a known troublemaker I'm deluged with more of this kind of stuff than most other people from groups seeking legitimacy. The hollow earth, N-machines, zero-point energy, and on. And on.

It's even worse in the alternative health field, where charlatans and the naive are making money by selling stuff to desperate people. But I read all I can, and look for claims that make sense, and can be supported by more than testimonials.

As I've mentioned a few times, when René sent me his *NASA Mooned America* book I sighed. Obviously another kook. But I dutifully sat down and started reading it. Hmm. As René made one scientifically valid point after another, all pointing to the impossibility of the Apollo moon trips' being real, I shared my thoughts with you and made arrangements to make René's book available. If I couldn't find holes in his reasoning, perhaps others could show me where he'd made mistakes.

So here we are with several hundred copies of the book having been read by people trying to poke holes in the admittedly preposterous idea that NASA, with the help of the CIA, has perpetrated a $4 billion fraud. The mail I've been getting from people who've read the book all indicate a reluctant agreement that René is right. Further, I've had several letters from readers who had their own good reasons for doubting the moon missions, but were afraid to say anything.

Oh yes, on the Earhart thing, I see that a woman is duplicating Amelia's last flight. But I'll bet her Lockheed Electra isn't equipped with the more powerful engines, extra wing tanks and cameras like Bob Wemple built into Amelia's plane so she could overfly Truk and get photos of the secret Japanese base there on her way from Lea, New Guinea to Howland Island.

Fried Brains

Old Worry-Wart Wayne and his EMF alarums is at it again. Yes, I know the power companies are spending what it takes to buy scientific proof that their magnetic fields are harmless, and that most of you dutifully swallow their testimony—though you do cast an apprehensive eye at those overhead power lines. Maybe—who knows, right?

Well, you haven't done your homework and I have. For instance, Dr. Peter French, one of Australia's top cell biologists, ran a test with brain cells which he irradiated with mobile phone RF for 10 minutes a day for a week. The result was a reduction of the proteins in the cells by as much as 70%, and he found that this damage was not repaired, even after many cell generations. Permanent damage to the brain cells. Is that what you want? If you must use a cell phone I suggest you use one of those cheap bag jobs and mag-mount the antenna on top of the car. Ditto your 2m HT—run coax to a roof mount antenna. Hey, by the time you've been through the American school system and a couple of decades of TV watching, you don't have a lot of brain left still functioning, so you can't afford to zap what's left with an HT or cell phone.

Diehards

Putting issue #21 of *Cold Fusion* together got me to thinking. Between the resistance of most scientists to anything they weren't taught in school and the rightful resistance to change of the power generation and distribution industry, it's not difficult to understand why cold fusion as a new non-polluting and inexpensive energy source is being either ignored or fought.

Early researchers ran into problems of reproducibility. Some groups sometimes were getting the excess heat that Pons and Fleischmann had claimed. Detractors quickly leaped to pooh-pooh the whole thing as sloppy laboratory work and calorimetry errors.

It turns out that once researchers started using thin films or powdered metal, where there was a large surface area for the reaction, some stupendous amounts of excess heat and dependable reproducibility resulted.

So where's all this heat coming from? You don't get something for nothing, despite the dreams of the zero-point energy enthusiasts. It's gotta come from somewhere.

The answer turned out to be fairly simple, though wading through the pages of equations proving it is not for the timid. There's a marvelous little book by Michio Kushi, *The Philosopher's Stone*—ten bucks from One Peaceful World Press, Box 10, Becket MA 01223. Kushi proves how simple it is to commit alchemy on the kitchen table. And he shows the chemistry to back it up.

That's right, the cold fusion phenomenon depends on the transmutation of elements for its excess heat. A Japanese group, led by Hideo Kozima, has been taking the experimental results from research groups all around the world and explaining the physics of what's been happening with their Trapped Neutron Catalyzed Fusion (TNCF) theory. While the math proving the validity of the concept may be complex and riddled with Greek letters, the basic idea is fairly simple.

The cold fusion effect works with metals which have a lattice-like structure, one in which hydrogen can be absorbed. Then, when you pass an electric current through the lattice which is packed with hydrogen, some of the neutrons trapped in this restricted area combine with the metal and electrolyte atoms to make elements of a higher atomic weight. In some cases there is a slight amount of mass lost in the transmutation. If you check the atomic weights on the periodic table of elements you'll see what I mean. Einstein's equation, $E = mc^2$, explains it. By the time you multiply even a small mass by the square of

Continued on page 87

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

As the summer hamfest season begins in earnest, here's a tip to keep in mind: Computer power supplies, the switching supplies used to provide 5 and 12 volts DC for the motherboard inside the average desktop computer, seem to abound at hamfests and computer swapmeets these days. The supplies are usually rated at anywhere from 150 to 300 watts output and will supply 5 volts DC at about 15 to 20 amps and 12 volts DC at 6 to 15 amps. Don't overlook their possibilities as a compact, lightweight alternative voltage source for your 12-volt DC ham gear. They'll quite likely supply the necessary current to power a VHF or UHF ham transceiver, medium power "brick" amplifier or several components needed to complete a packet node or PBBS station...often at next-to-giveaway prices!

I recently came upon a couple of these supplies that had been used in older, bulkier IBM AT PC cases, the other parts of which had been transferred to newer, smaller-profile cases. Although one has to be careful in using switching power supplies around radio equipment (they can generate quite a bit of RFI and desensitize a transceiver's front end), most of the better supplies are pretty well shielded and RFI-proofed. It helps if you eliminate all of the unused output leads (of which there are often many) by cutting them off, taping up the ends and turning them back inside the case. Only those supplying 12 volts DC and ground are needed. Now the supply can be checked out with a hand-held transceiver (preferably on the same band as the equipment to be powered will be operating) by using the handheld's rubber duck antenna as a probe. If there is still some noticeable RFI from the power supply, it's often possible to further reduce it to acceptable levels by using a shielded primary AC power cord, and by installing ferrite beads on the output DC leads, just before they exit the supply's case (or by passing the leads through a toroid core a couple of times on their way out). Sometimes, just keeping a bit of distance between the supply and the radio itself is all that's needed. If the radio is being fed from an external antenna via well shielded coax, then the chances of successfully using a "recycled" computer switching supply are even better. The main point here is not to overlook the possibility of using these supplies as compact, lightweight bench and RF equipment alternative power sources just because they were made for computer service.

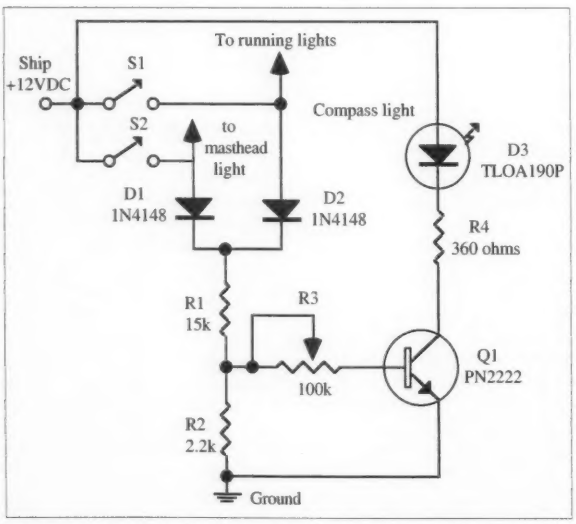


Fig. 1. *N4UAU's solid-state compass "night light" idea. The compass light is illuminated when either the masthead light or the running lights are on. Potentiometer R3 controls the LED's brightness.*

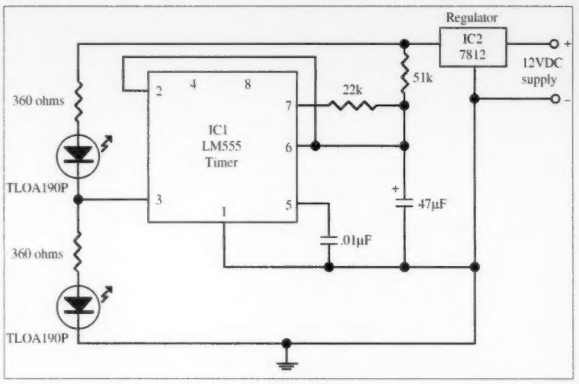


Fig. 2. *N4UAU's "winking" pumpkin eyes. LEDs D1 and D2 will alternately be lit for approximately one-second intervals.*

A bright spot at last!

From Sam Ulbing N4UAU: "After reading Frank Brumbaugh's article titled 'A Low Current Light' (*73 Amateur Radio Today*, November 1996), here's an expansion (and perhaps a different twist) that I've uncovered. For over a year now I've also been using an LED as the main element in a 'non-night-blinding-flashlight' for my sailboat. The particular LED I use is somewhat unusual, and if anyone else might be planning to build a low-current, easily portable flashlight, I'd recommend something like this one.

"The LED I'm using is a Toshiba TLOA190P(WX) (available from Hosfelt Electronics), but what makes it unusual is that it's rated at 18,000 to 36,000 mcd. That's a lot of mcds when you consider that the average LED is somewhere in the range of 10 mcd, and the so-called 'Super Ultra Bright' jobs are about 3,000 mcd. This baby is bright!

"The color of the TLOA190P (WX) is described as orange in the catalog, but I'd call it red. While Frank brought up the point that red attracts insects, I've found it to be an ideal color out on the water, because it doesn't cause night-blindness as other colors might. This is a very real concern to a night-sailor, and perhaps to others who are involved in pursuits where maximum retention of night-vision is an important factor to consider (campers, drivers, pilots, security and police officers, etc.).

"I'm using the TLOA190P(WX) LED as a low power light source in several ways. I've outlined some examples below:

• I have two AA alkalines, a small slide switch and 20Ω resistor all taped together (I'm not what you might term a 'case-building expert'). The switch and LED fit nicely along the side of a two-cell AA battery pack, and the package is simply wrapped in electrical tape. It's small enough (2.75" by 1.75" by .75"), and it's the flashlight of choice that I carry with me on my sailboat. I can illuminate up to the tip of my masthead, some 55 feet up from the deck, and check on the wind telltales with this little beauty... that takes a bright light! With a 20Ω current limiting resistor, current drain is only about 30mA from the 2,000+ mAh available from good quality alkaline AA batteries; that equates to better than 65 hours of continuous use!

• I've also built a small LED flashlight onto a floating keychain, using a single-cell 3V lithium battery and a combination of a slide switch and a mercury switch as the activation devices. When I'm on the dock at night I'll turn on the slide switch, and if I accidentally drop the keys into the water, they'll float upside down

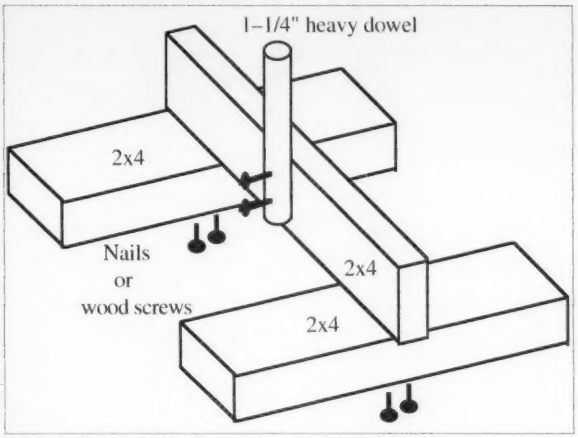


Fig. 3. *AD1B's attic beam antenna suggestion.*

and turn on the LED so that I can find quickly them. I used a 100Ω resistor in this application in order to keep the current draw low, so that the single lithium battery would last longer.

• I also use one of the TLOA 190P(WX) LEDs as my sailboat's compass light. The red light is more than sufficient and, again, doesn't affect my night-vision. Red is typically the color that all sailboats use for compass illumination, but the LED will last virtually forever. In this application, I'm also using a dimmer circuit (shown in **Fig. 1**) so that I can adjust the brightness according to my needs. The LED doesn't affect the compass's accuracy, since the low current drain results in a very small extraneous magnetic field.

• I tried using several TLOA 190P(WX) LEDs for the purpose of chart table illumination as Frank suggested. I tied several together in series, with a single current limiting resistor, and powered the series string from the ship's 12V battery, but these LEDs are so spot-focused that it didn't work well enough for me in this application. All I achieved were several bright red spots, fairly close together. Perhaps a less bright, less spot-focused LED would work better (as Frank recommended in his article), or perhaps a defocusing (diffusion) lens arrangement would help. I didn't feel that it was worth the effort in my own case to experiment any further at the time.

• I use the LED as a general night light on the boat... actually, I leave it on all the time. With a 2.2k resistor in series with the Toshiba TLOA190P(WX) and powered by the ship's 12V battery, current draw is a minuscule 5mA and it projects a nicely focused light on the companionway steps leading below decks.

• I've found that it's even useful for holiday decorations. As just one example, I put two of these Toshiba LEDs into a carved Halloween pumpkin, along with a little solid-state flasher circuit, to achieve a pair of 'winking goblin eyes,' much to the delight of the neighborhood kids! **Fig. 2** shows the basic LM555 flasher circuit that I used. There must be some application hidden in here for Christmas as well!

"No doubt there are many other uses for the Toshiba TLOA190P(WX) LED that I haven't touched on—let's see some more suggestions here in the 'Ham To Ham' column...we don't always have to talk radio! By the way, this LED is priced rather steeply at $3.50, but I feel that it has so many uses that it is worth every penny. LEDs have such long life expectancies, that prorated, over time, the cost is minimal. Like all solid-state lamps, however, be sure that you limit the current to a safe value with an appropriate series limiting resistor. This particular LED can handle 60mA, far more than most, but a 12V battery could destroy it instantly without the correct series limiting resistor. As mentioned before, this particular LED is bright enough, and focused enough, that you can actually see it on a wall 10 to 15 feet away... even during the daytime. It might even be used as an inexpensive 'laser pointer' for low-budget business presentations. And as with a laser, be very careful not to shine this LED into a person's (or pet's) eyes. It is quite intense and might very well result in damage. As with everything else, using common sense and obvious safety precautions, this LED has some interesting potential applications."

Moderator's note: Sam is a noted author of technical articles who enjoys sailing in his free time. Our thanks go to Sam for sharing these ideas with us and for a different look at the current possibilities with solid-state lighting. I've a feeling that it will be interesting to see what the future holds in this area of electronics.

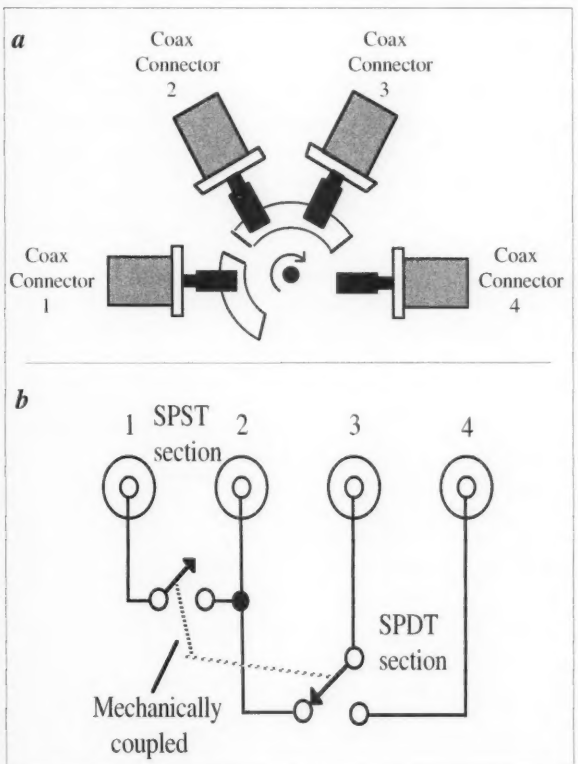


Fig. 4(a). *Rear internal view of the B&W Model 551A coaxial bypass switch showing its inner construction. It's basically an SPDT switch (via connectors 2, 3, and 4) ganged with an SPST "secondary" switch (via connectors 1 and 2). The switch is shown in its normal (nonbypassed) position.*

Fig. 4(b). *Schematic of B&W Model 551A.*

Beaming with pride

From Tom Hart AD1B: "A number of years ago, I bought a three-element Hilltopper™ beam for six meters. In fact, it was back in about 1968 and I suppose you could say I've been somewhat remiss in getting it up and on the air! But after all, this is 'just a hobby' and there's no big rush!

"At any rate, after purchasing the new MFJ 6-meter SSB rig, I decided it was now time to install my 3-element beam...still in its original box! A necessary adjunct to any antenna package includes a system for supporting it, as well as a rotation method and all the necessary cabling. Taking another look around at my yard and garage, I didn't see a good place to install everything in terms of 'quickly and easily,' two priorities in this project. My thoughts then turned toward the possibility of a third-floor attic installation. I considered the less-than-optimum height factor and the inside-the-roof losses,

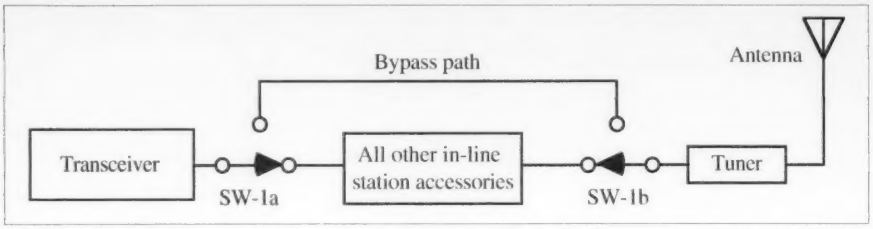


Fig. 5. *Coaxial bypass switch being used to completely bypass all in-line accessories (with the exception of an antenna tuner) to eliminate potential sources of trouble quickly... without having to sign off the air.*

but decided to give it try anyway. After all, it's just a hobby!

"Fortunately, my attic has ample room, so I set about designing the simple-to-build support structure (shown in **Fig. 3**). It had to be small enough to make it through the trapdoor access to the attic, yet large enough to support the beam and rotor as well as span the spacing between the attic rafters on which it sits. The bottom housing of the rotor, though not shown in the drawing, rests on the cross-2x4, maintaining the lowest possible profile and also adding to the stability of the installation. The beam, then, is mounted on another 1-1/4" dowel rod clamped to the top half of the rotor's housing, completing the mechanical installation. The two 2x4s that span the rafters can be glued, tied or perhaps screwed in place, to prevent any shifting of the mount during operation, if the sheer weight of the support system doesn't seem to be enough in terms of holding power in your particular case...it's an individual judgment call.

"I've been very happy with the results, it was easy to build and install, and it's served my purposes nicely. Wind and weather are obviously not considerations, and the beam should easily last another 30 years! Though not intended as a big DX grabber, my own primary interests on six meters are local contacts and checking into a few area nets. The indoor location has done that for me nobly. In fact, I'm now looking forward to building a two-meter quad to go above the six-meter beam!"

Moderator's note: Wow, Tom's attic must be a lot taller than mine, but his suggestions are well taken. Keep this easy support structure in mind if you think you can use an attic installation, perhaps to comply with no-outdoor-antenna covenants, or just to keep a lower profile in your overall antenna farm needs. Tom's support could even be taken up to the attic in pieces, and the final assembly quickly completed via pre-drilled holes for long wood screws, or it might simply be glued together in-place (using either hot-melt or quick-setting liquid adhesives). Before installing any antenna in your attic, however, make a quick RF check at or near the frequency that you're interested in using. Some asphalt shingles have aluminum strips on their underside... used to keep the 'seal-tab' from sealing to the next shingle before installation. These unseen metal strips can wreak havoc on the passage of RF energy through a roof covered with this type of shingle... I know first-hand—I've got them! After my new roof was installed a number of years ago, my off-the-air television reception was almost nonexistent from my attic-installed TV antenna. The next time my home needs reroofing, those shingles are going! A small battery-operated TV set or ham hand-held transceiver operated from up in the attic should tell you immediately if your shingles are the of the RF attenuating variety or not. A pocket TV tuned to Channel 2 to 6 will indicate how well six meters might work. Channels 7 to 13 give you a good idea about losses near our two-meter and 220 MHz bands. The UHF TV channels can be used to judge the results you might expect on 70 cm and above.

Don't bypass this!

From Ken Guge K9KPM: "You've probably seen them at hamfests, but perhaps you've simply walked by...I'm referring to those B&W bypass coax switches. Barker & Williamson makes a coax switch that can be used for bypassing a linear amplifier, receiver preamp or other coax-fed accessory... in case you might want to switch the device out of the circuit at times, with just a flick of the wrist. Sure, your linear amp already has a built-in bypass relay, and maybe your transceiver's RF preamp does too, but wait, that's not all that these handy bypass switches can do.

"If you'd like to be able to route your transceiver's signal around everything, all at once, the bypass switch can do it for you easily. Most of us have the output of our transceivers feeding into an SWR-metering circuit of some sort, maybe an external RF signal preamp, perhaps a linear amplifier, a monitor scope, an antenna tuner (variable antenna matching network), a low-pass filter, and often other necessary 'accessories,' all of which can cause problems of their own. Loose PL-259 coax fittings, bad cables, intermittent internal connections can all interrupt our QSOs even when the transceiver itself may be operating perfectly. A coaxial bypass switch in line is the answer and **Fig. 5** shows the idea in block diagram style. Just throw the switch into its bypass position and you can instantly work around any and all of these potential QSO spoilers! You can always troubleshoot the defective device later on—the main objective here is to keep you on the air now.

"A coaxial bypass switch can also be used to effectively ground your antenna's transmission line, and your transceiver's input, when the station is shut down for the night. **Fig. 6** shows one such arrangement. Of course you'll want to be sure to remember to place the switch in the ON-AIR position whenever you're going to operate, but its QRT position will help to protect your equipment from lighting or static-induced damage when it's not in use.

"On the test bench, a coaxial bypass switch can come in very handy for checking the results of a unit-under-test, by permitting you to quickly switch the unit in and out of the circuit (such as an RF preamp), in order to judge more accurately whether the unit is doing what it's supposed to do.

"I would guess that all the previously mentioned uses are more or less what the switch manufacturer had in mind when the decision was made to offer a product like this to the amateur radio market...but there's one more! I doubt that B&W

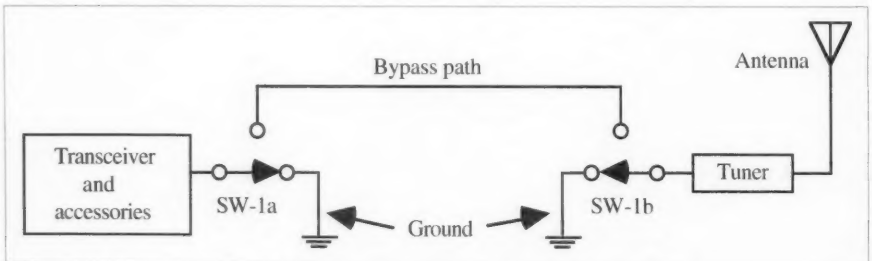


Fig. 6. *Coaxial bypass switch grounds the station antenna and the transceiver's input during non-operating times to offer some protection against lightning and static-induced voltages.*

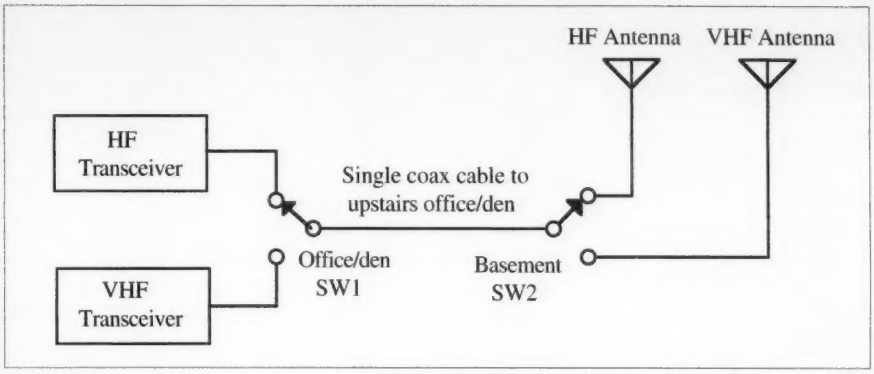


Fig. 7. *Two coaxial bypasses being used as A-B transfer switches to permit one transmission line to serve for both HF and VHF operation at different locations within the same home station setup.*

really intended their 551A coax bypass switch to perform as a two-position coaxial selector switch, but it can. If you look at how the switch is internally constructed in **Figs. 4(a)** and **4(b)**, you can see that it's basically an SPDT switch ganged with an SPST 'secondary' switch. Ignoring the SPST 'secondary' section and connector #1, you can utilize the SPDT section as a standard two-position coax switch (an A-B switch). For instance, connecting a coax cable between connector #3 and your transceiver's output, you can switch between two separate antennas connected to connectors #2 and #4. You can also use the same idea in reverse to select between two transceivers and one antenna by connecting the antenna to #3 and the transceivers to connectors #2 and #4 respectively.

"I'm using a variation on that idea in my own station as shown in **Fig. 7**. In the cold weather, I prefer to do my HF and VHF operating from my upstairs office/den, rather than from the chillier basement ham shack. With an SPDT coax switch on each end of the line, I can use a single coax cable running up to the den by using the **Fig. 7** hookup. There are many other uses, limited only by your imagination and your own particular switching needs. I hope these suggestions have provided some food for thought for fellow 'Ham To Ham' readers...and remember: Don't pass up this little gem at your next hamfest, it's not just for bypassing any more!"

Moderator's note: Ken always seems to bring out innovative and surprising uses for devices that many of us would never have thought of on our own... thanks for another, Ken. By the way, the manually activated bypass switches that Ken referred to come in voltage-actuated coax relay form as well. I've been using a 120V AC actuated coax bypass relay in my own station to switch my conglomeration of in-line accessories out of the circuit between my transceiver and my antenna in an emergency...and it works nicely (I've had to use it a few times, too!). Again, you can often find these bypass relays at hamfests with 6V, 12V, 24V and 120V coils (both in AC & DC varieties). Just be careful that you know what voltage you're buying and that the coil reads continuity with an ohmmeter (you do carry a pocket-sized VOM with you to the hamfests, don't you?).

Murphy's Corollary: Any electronic component, selected at random, from a group of components having 99% reliability, will fall into that 1% remaining category!

Remember to keep your ideas coming this way; I'm always looking for worthwhile tips, ideas, suggestions, shortcuts and innovative ways of doing things in and around the ham shack... like those in this month's offerings. So again, as always, many thanks to the contributors to this month's column, including:

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NEVER SAY DIE

Continued from page 83

the speed of light you have a huge amount of energy released. This is how Dr. Patterson's CETI group has been able to demonstrate efficiencies of up to 2,000 times more energy being produced than is going into their test cells.

No, they didn't teach the transmutation of elements when I went to college. They're *still* not teaching it, but they will be in a few years. Heck, when I went to college the very idea of solid state electronic devices was ridiculous. If anyone had been able to teleport a Power PC chip back through time the entire resources of the world could not have duplicated it, much less today's LCD color laptop screens.

My predictions of four years ago, when I started writing about cold fusion, haven't changed—they've only been substantiated by researchers in Japan, Russia, Italy, India, France, and the US. I'm more convinced than ever that this is going to be one of the largest industries in the world in another 20 years.

Hey, you snickered and ridiculed me 20 years ago for writing in my editorials that the personal computer would one day rival the automotive industry in size, with computers in every home. Now I chuckle every time I hear a radio ad for software, or see TV ads for personal computers.

And just as the opportunities for getting in on the ground floor were there for the enterprising 20 years ago in the computer field, today they're wide open in the soon-to-be new energy field. Will Dennis Cravens, who started out building cold fusion reactors in his basement a few years ago, be one of tomorrow's zillionaires? The chances are very good. Despite the enormous resistance of our scientific elite and the power companies, Dennis and Doc Patterson are laying th

e groundwork for a world ß"of almost unlimited low-cost non-polluting energy. And Dr. Kozima is busy explaining to any of the scientific community not totally blindered the hows and whys of what's happening. 73

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Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the September 1997 classified ad section is July 10, 1997.

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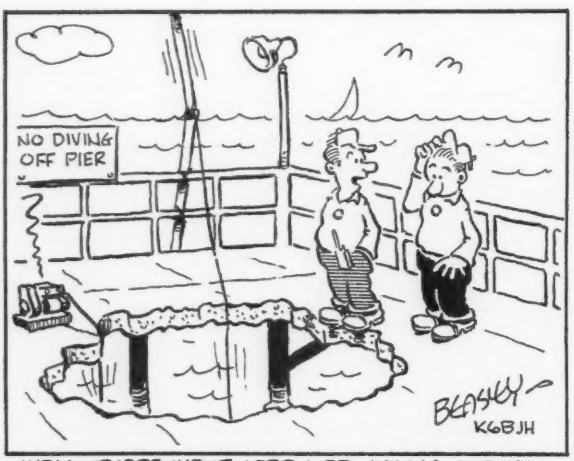

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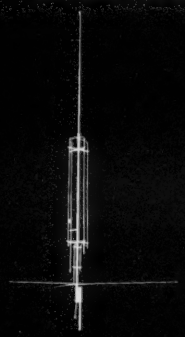
GAP: THE PERFECT ANTENNA

We at GAP realize there isn't a perfect antenna. No singular antenna will scream DX on 80 and be the best for local nets on 10. If anyone tells you there is, beware! The perfect antenna does not exist, but the right one for you may. If you want something to bust the pile on the low bands, then consider the Voyager. Just starting out in ham radio and need a great general coverage antenna, the Challenger is easy to assemble and for little effort will yield superior performance, especially on DX. Maybe you knowingly or unknowingly moved into one of those "restricted areas" where the Eagle's limited visibility, but unlimited ability is desired.



Eagle DX

Challenger DX

Voyager DX

This chart helps you select the right GAP antenna. When comparing GAPs, bandwidth is not a concern. With few exceptions, a GAP yields continuous coverage under 2:1 for the **ENTIRE BAND**.

All antennas utilize a GAP elevated asymmetric feed. A major benefit is the virtual elimination of the earth loss, so more RF radiates into the air instead of the ground. This feed is why a GAP requires **NO RADIALS**. Just as elevating a GAP offers no significant improvement to its performance, adding radials won't either, making set up a breeze.

A GAP antenna has no traps, coils or transformers. This is important. The greatest sources of failure in multiband antennas are these devices. Perhaps you heard someone discuss a trap that had melted, arced or became full of water. Improvements to these inherent problems are the focus of the antenna manufacturer, while the basic design of the antenna remains unchanged. **GAP improved the trap by eliminating it!** Removing these devices means they don't have to be tuned and, more importantly, won't be detuned by the first ice or rain. The absence of these devices improves antenna reliability, stability and increases bandwidth.

Another major advantage to a GAP antenna is its NO tune feature. Screws are simply inserted into predrilled holes with a supplied nutdriver.

The secret is out and people in the know say:

CQ–"The GAP consistently outperformed base-fed antennas...and was quieter."

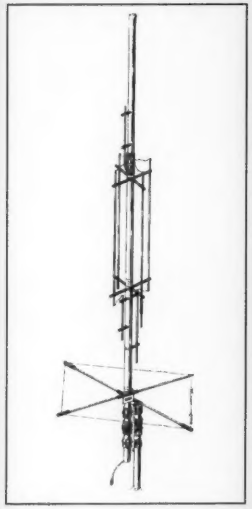
73–"This is a real DX antenna, much quieter than other verticals."

RF–"To say this antenna is effective would be a real understatement. Switching back and forth on 40m between another multiband HF vertical and the GAP, there was no comparison. Signals were always stronger on the GAP, sometimes by S units, not just DB's."

Worldradio – "These guys have solved the problem associated with verticals. That is, an awful lot of RF is wallowing around and dropping into the dirt instead of going outward bound. A half-wave vertical does need radials if it is end fed (at the bottom). But the same half-wave vertical does not (as much, hardly at all) if is fed in the center."

IEEE–"Near field and power density analyses show another advantage of this antenna (asymmetric vertical dipole): it decreases the power density close to the ground, and so avoids power dissipation in the soil below it. The input impedance is very stable and almost independent of ground conductivity. This antenna can operate with high radiation efficiency in the MF AM standard broadcast band, without the classical buried ground plane, so as to yield easier installation and maintenance."

Latest Release: **TITAN DX**



This all purpose antenna is designed to operate 10m-80m, WARC bands included. It sits on a 1-1/4" pipe and can be mounted close to the ground or up on a roof. Its bandwidth and no tune feature make it an ideal antenna for the limited space environment as well as a terrific addition to the antenna farm.

MODEL	BANDS OF OPERATION											HT	WT	MOUNT	COUNTER-POISE	COST
	2m	6m	10m	12m	15m	17m	20m	30m	40m	80m	160m					
Challenger DX	■	■	■	■	■		■		■	■		31.5'	21 lbs	Drop In Ground Mount	3 Wires @ 25'	$259
Eagle DX			■	■	■	■	■		■			21.5'	19 lbs	1-1/4" pipe	80" Rigid	$269
Titan DX			■	■	■	■	■	■	■	■		25'	25 lbs	1-1/4" pipe	80" Rigid	$299
Voyager DX							■		■	■	■	45'	39 lbs	Hinged Base	3 Wires @ 57'	$399

GAP ANTENNA PRODUCTS INC.
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Vero Beach, FL 32967

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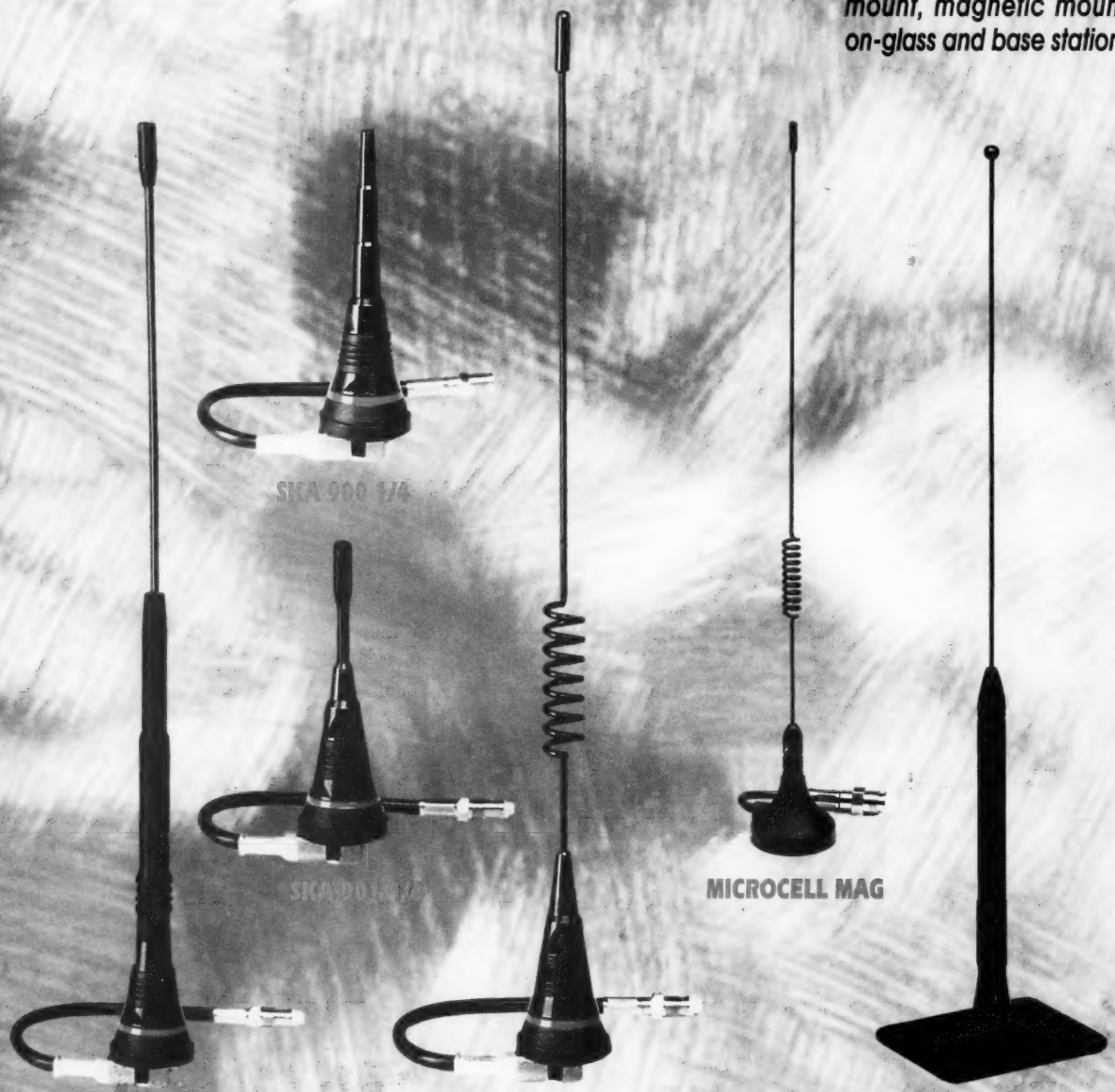

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